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THE CIVIL WAR IN CUBA.

THE efforts thus far made by the Spanish government to put down the uprising in Cuba have proved signally inefficient, and the dispatches daily give accounts of minor engagements of the Spanish troops with the insurgents in all parts of the island, from which it is difficult to determine with which side any temporary advantage may lie. Of one thing, however, there appears to be absolute certainty, and that is that large numbers of the plantations have been and are being wrecked and burned, and that the damage to the crops thus far has been enormous. The railways of Cuba are not numerous, but they are designed to bring all the large producing districts into convenient communication with some shipping point. To destroy these lines, in order to most effectively sap the resources of the government, as well as to prevent the quick movement of troops from one point to another, has been one of the main objects of the insurrectionists, and one of our illustrations exhibits the results of this policy, the scenes presented being such as may be met with in many parts of the island. So general, in fact, has the interference with railway business become, that the plan has been adopted, on several roads, of sending out an armored pilot locomotive ahead of a train to fight its way through bands of the enemy who might be disposed to dispute the passage. An engagement of this character affords the subject of one of our illustrations. The arrangement of the extemporized forts upon the locomotive cab and tender bring to mind some of the plans which have been suggested for the protection of express cars from train robbers in the West and Southwest.

The appointment, January 19, of Gen. D. Valeriano Weyler to succeed Martinez Campos as Captain General of the island, indicates the firm resolution of the Spanish government to exert its powers to the utmost to suppress the rebellion by the severest possible military policy, rather than by making concessions in the line of a more liberal government. Gen. Weyler had a subordinate command in the suppression of the rebellion in Cuba in 1868-78, when he made for himself a reputation for especial harshness and severity. The Spanish government gives Gen. Weyler 25,000 fresh troops for his task, and he announces that he comes to meet war with war, and has nothing to do with reforms. Of the situation in which he found affairs on the island when he arrived in Cuba, early in February, a correspondent of the New York Sun writes as follows:

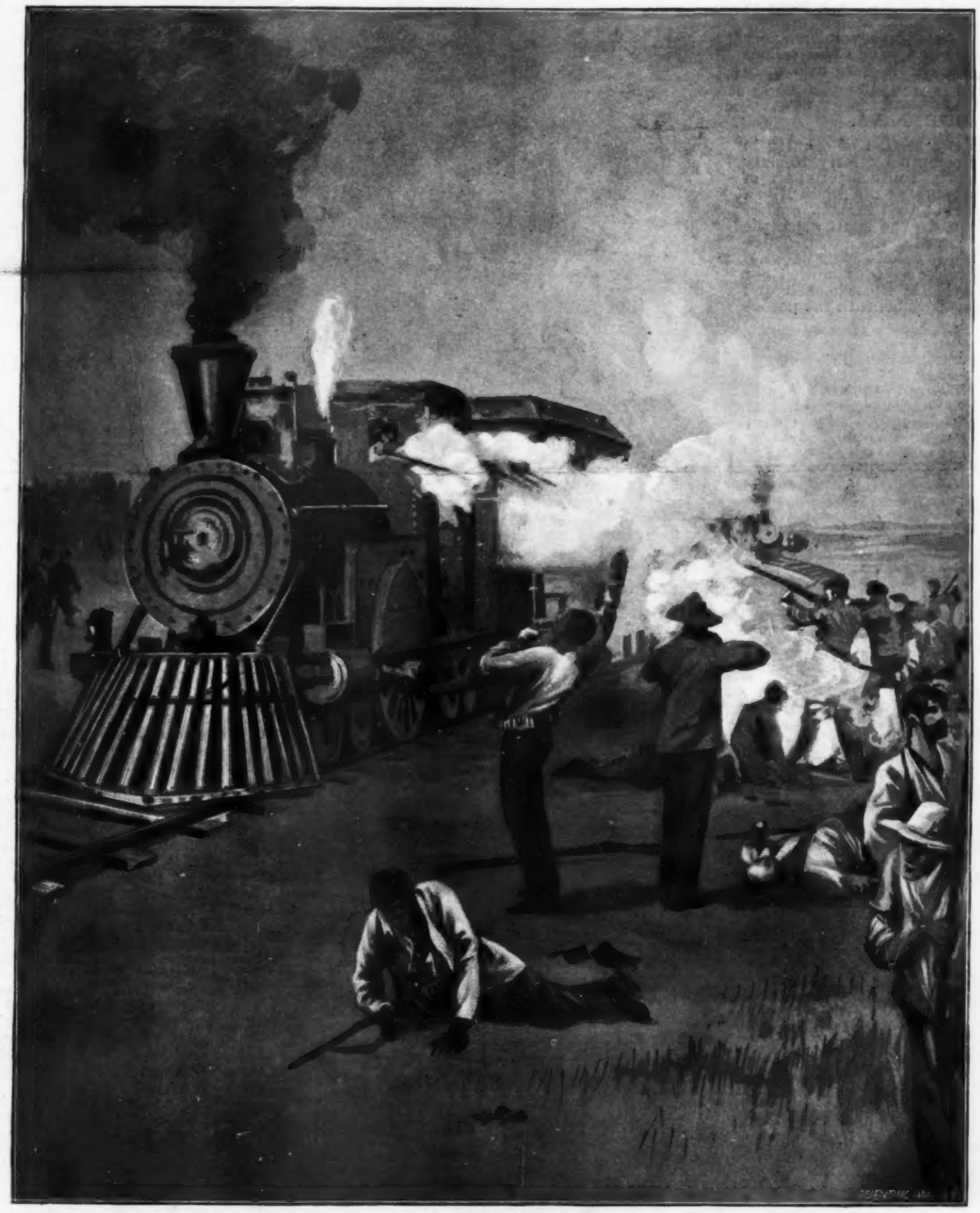
"Martinez Campos goes back to Spain and leaves his successor with bands of rebels moving apparently at will through the interior of the island from one end to the other, and their numbers cannot be estimated with any accuracy. Those not in arms are so strong in their sympathies that almost every born Cuban can be counted as a rebel at heart. What is called the army of liberation is now ably commanded, has some pretense of discipline, and is for the most part armed and equipped with rifles and ammunition taken from either the Spanish regulars or the Spanish volunteers. It fights only a guerrilla warfare, but it preserves itself from annihilation, and Spain certainly has a big job to put it down. Cubans tell me that they do not expect to defeat and crush the Spanish army, but that they hope to extinguish Spain's resources and bring her to terms. Gomez and Maceo are still operating near Havana and say they are to make the war in this part of the island. The rebel army of the east is on the border of Matanzas and will soon unite with the other forces. Should any detached portions of the Spanish army get mixed up with these wings of the rebel army there may be a genuine battle, but otherwise the operations of the future will follow the lines of those in the past."

During the first days of Gen. Weyler's administration he has issued a number of proclamations which cannot fail to bear with extreme severity upon all noncombatants, putting the entire island under the most rigid martial law, and deputing to the several commanders authority to punish with immediate death all infractions of his stringent regulations. Beginning at the eastern part of Cuba, where the insurgents have full sway, outside the garrisoned towns, the general orders everybody to leave the country regions and gather at the different military headquarters, where they will be under surveillance. Even the stores are to be abandoned to the government, and any sort of property which does or may afford a hiding place for rebels may be destroyed in the discretion of the district commander. Gen. Weyler assumes supreme judicial authority and delegates it to the military commanders in certain cases, their action to be subject to his approval. Among those who are proclaimed enemies to Spain, to be punished by death or life imprisonment, are "those who by word or through print or in any other manner belittle the prestige of Spain's army, volunteers, firemen or any other force operating in the army, and those who by the same means endeavor to praise the enemy."

It will be remembered that the preceding rebellion in Cuba lasted ten years, from 1868 to 1878. It is said to have cost Spain $850,000,000, and there is still a debt on this account of $170,000,000. It is said that there were at no time so many men under arms, or such large districts threatened, under the preceding insurrection, as has been the case under the uprising which commenced last spring, and has seemed to grow in strength with each succeeding month.

The accompanying maps show the Spanish and Portuguese possessions in America in 1795 and 1895. A hundred years has seen the abrogation of the claim of Portugal, which covered Brazil only, while that of Spain, which covered all the rest of South America and a large part of North America, is now confined to a total of some 45,000 square miles, in the two colonies of Cuba and Porto Rico. Brazil became independent without war, but all of the Spanish American countries fought their way to independence of the mother country. The causes impelling the insurrectionists in Cuba in a similar course are thus summarized by one of their spokesmen, Hon. Fidel G. Pierra:

"The Cubans have neither vote nor voice in the imposition of the taxes or in the expenditure of the revenue. All that is done in Spain. They are taxed every year to the extent of $25,000,000 or $30,000,000, of which only some $700,000 is applied nominally to internal improvements in the island, and, as a rule, not more than one-half or one-third of that sum is disbursed for that purpose. Of the rest of the revenue, $11,000,000 goes to pay interest on the debt of Spain; $7,000,000 to pay for the army and navy of Spain, and $8,000,000 for salaries to Spanish employes in the island and out of the island. The Captains General have ruled the country with an iron rod. On the merest suspicion, or prompted by prejudice or dislike, they have, without any form of trial, imprisoned persons, banished them from the island, deported them to the penal colonies of Africa, or ordered them shot, and, moreover, confiscated their estates and left



THE WAR IN CUBA—INSURGENTS ATTACKING AN ARMORED PILOT LOCOMOTIVE.

their families in poverty and destitution. During the last seventy-five years there is not one single Cuban family some one of whose members has not suffered persecution or death."

The Toledo battalion that arrived in Santiago de Cuba December 6 had been stationed at Valladolid. It consists of 38 officers, 30 sergeants and 857 soldiers. The battalion was received with great demonstrations of sympathy. The balconies of the houses in the streets through which they passed were decorated with hangings, the public buildings were closed and a committee of the Junta, presided over by Señor Berrueco, went on board to extend a welcome to the new comers, for whom several committees bearing standards were waiting on the wharf. The photograph from which our engraving was made was taken at the moment when the first company arrived at the wharf. Until the battalion started for its destination, it was quartered in the new sheds of the department of harbor works, where they were made very comfortable.

We also publish an engraving of a mixed train of the Caibarien Railroad that was burned on the plantation of Cien Rosas. On this same line a little fort has been constructed for the purpose of defending the bridge that crosses the San Andres River.

Other engravings from La Ilustracion give a clear idea of the way in which the war is carried on, showing different views of the blowing up of the train in which General Suarez Valdes went from Cifuentes to Santa Clara in the latter part of November, and the burning of the station at Taguayabon. The train was blown up in the culvert of Santa Rita, where the party of Robert Bermudez had placed a dynamite bomb. The sills of the little bridge were thrown to a considerable height and then fell to the bottom of the ditch. The third class coach was almost entirely destroyed. It contained twenty-five soldiers, very few of whom escaped without bruises or more serious injuries. The officers and passengers were also more or less injured.

BENEATH THE LAVA.

THE great lava flow covers a section of country in Idaho four hundred miles in length by forty to sixty miles in width. It lies in the southeastern part of the State, on and along the course of the Snake River, and mostly on the north side of that stream. After flooding the great plain lying to the southward, the lava turned and flowed backward to the north. There it flowed into the mouths of the valleys lying between the foot hills, filling all the streams that flowed out toward the south. The streams thus checked and dammed presently found passages beneath the porous

SPANISH POSSESSIONS IN AMERICA, 1895.

lava, and now flow under it from thirty to fifty miles, to reappear as large springs or to burst forth in cascades and tumble down the walls of basalt that border Snake River.

On the line of the back flow, up toward the northern foot hills, lies the most ragged and forbidding portion of the great lava plain. The Snake or Shoshone forms the great center of the Idaho river system. It has a course of 850 miles within the State, and, with its branches, drains nearly the whole country. The Clearwater, the Salmon, the Weiser, the Fayette, the Boise, the Lemhi, the Owyhee and other rivers, tributary to the Snake, were wonderfully rich in gold.

The Yankee fork of the Salmon and many other creeks were exceedingly rich in the yellow metal. Rich placers were found in the streams that formed the Boise River in 1862; in the year following in the tributaries of the Owyhee and many other places. The valleys of the Weiser and Fayette, constituting what was known as the "Boise Basin," was one of the richest placer regions ever found. What are called basins in Idaho are not bowl-shaped depressions, as many suppose, but are sections of low country surrounded by large mountains.

Within the basins are many hills and creeks. The Florence Basin was astonishingly rich and many others were little behind it as producers. Prior to 1868 these basins and other surface diggings in little flats and on gulches produced $45,000,000. Up to 1873, by which time most of the famous placers had been worked, the yield from the surface diggings amounted to $75,000,000. Then began the rich discoveries in quartz, but placer mining is still continued and occasionally rich finds are made. From what has been said of the rich deposits of gold in the basins, valleys, gulches, flats and streams of Idaho, it is reasonable to suppose that under the great lava flow covering an immense area—not less than 20,000 square miles—in the heart of the auriferous region must lie many exceedingly rich deposits of gold. The gold placers of both California and Idaho are countless ages older than the lava flows. In California the channels of the ancient rivers beneath the lava are much richer than those of the modern rivers and placers. This is because the channels of the ancient rivers had served as bedrock sluices for untold ages before the disturbing lava flows began. The present rivers of California received the greater part of their gold by their cutting across and carrying away great sections of the rich channels of the ancient rivers.—Engineering and Mining Journal.

SPANISH (AND PORTUGUESE) POSSESSIONS IN AMERICA. 1795.

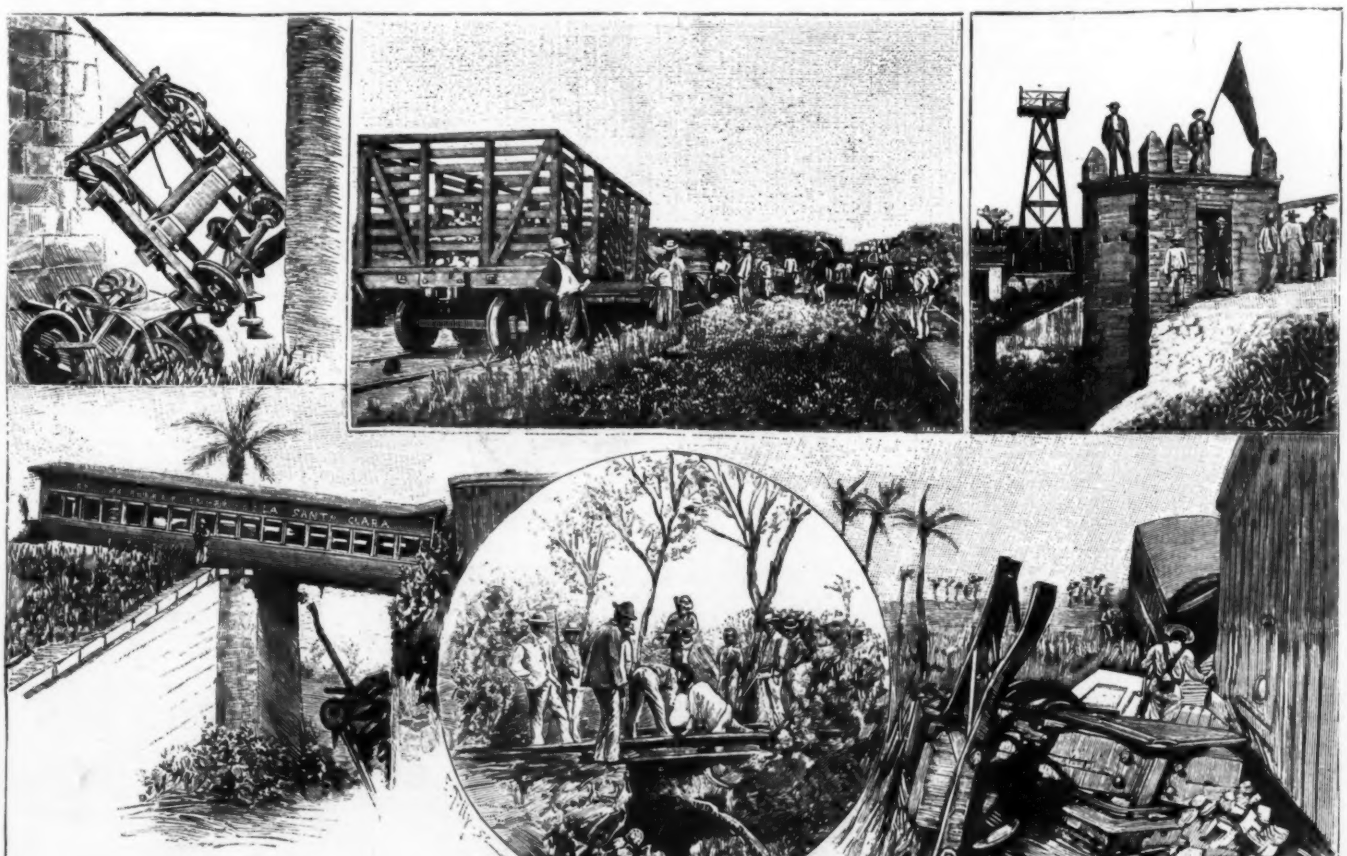
ARGON AND HELIUM.

"AT the Royal Institution recently," says the hemical Trade Journal, "a large audience assembled hear Lord Rayleigh give some further particulars bout argon. Sir Frederick Abel was in the chair. d among those present were Sir Benjamin Baker, r James Crichton-Browne, Sir Douglas Galton, rof. Dewar, Prof. A. B. W. Kennedy, Prof. Ramsay, . Frankland, Prof. D. E. Hughes, Mr. Thornycroft, rof. S. P. Thompson, Prof. Roberts-Austen, and rof. Vernon Boys.

"Lord Rayleigh first dealt with the density of argon. At the meeting last year he had, he said, only been able to speak of the density of argon prepared by the magnesium method. It was at that time his aim to weigh argon prepared by the oxygen method, and it was important to do so in view of the question whether argon prepared by the magnesium method was the same gas as that obtained by the oxygen process. He mentioned the difficulties he had to meet in getting three liters of argon, the amount with which he had been accustomed to work in his determinations of the densities of other gases. These difficulties were mainly due to the slow rate at which the nitrogen could be eliminated by means of the electric spark. He described the improvement he had effected in his apparatus at the suggestion of Prof. Ramsay. The nitrous fumes formed in the process were absorbed by alkali, and Prof. Ramsay's suggestion was to produce a fountain of alkali in the vessel, and so expose a larger surface for absorption of the gases. Another advantage gained was that the alkali solution welling up protected the glass from the heat of the flame. The voltage employed was about 3,000. In this arrangement nitrogen and oxygen were combined at the rate of about 7 liters an hour. One curious effect was noted. Though the fountain made it quite possible to use a large arc in a small vessel, yet it was found that, everything else being equal, in these circumstances the rate of absorption was very much reduced. The determination ultimately made by Lord Rayleigh of the density of argon prepared in this apparatus was 19·940, which almost exactly equaled that found by Prof. Ramsay for the gas obtained by the magnesium process. This fact allowed the inference that the gases prepared by the two processes were identical, and also suggested, though it did not prove, that the gas was not a mixture. It was also unfavorable to the view supported by some eminent chemists that argon was an allotropic form of nitrogen, since the weight of that modification should be 21. Lord Rayleigh then spoke of the refractive index of argon, and after giving some account of the method he employed in estimating it, stated it to be 0·96, air being taken as 1. From the fact that the refractivities of air and argon were so nearly alike it might again be inferred that argon was not the allotropic form of nitrogen represented by N_3, ordinary nitrogen being N_2. Passing to his examination of the gas given off by the Bath springs, he said the proportion of argon appeared to be less than existed in the air. Subsequently, however, Prof. Ramsay discovered helium, and then it occurred to him as an explanation of this that helium, being as inert as argon, might be present in the residue, and by its lightness compensate for the heaviness of the argon. He found the line D_3, too, unmistakably in the spectrum of the residue of this Bath gas, and that showed the presence of helium; he did not, however, consider it was present in sufficient quantities to make the explanation just suggested tenable. In gas from springs at Buxton there was some 2 per cent. of argon, with a doubtful indication of helium. The question whether there was helium in the atmosphere was an interesting one, but experiments seemed to show that there was not one part in 10,000 of air. It must, however, be present in a mathematical sense, seeing that it was given off by certain springs. Lord Rayleigh concluded his lecture by some remarks on the viscosity of argon, which he found to be 1·21 as compared with air."

HIS EXCELLENCY GENERAL VALERIANO WEYLER, IN COMMAND OF THE SPANISH FORCES IN CUBA.

THE Philadelphia Natural Gas Company, of Pittsburg, have a larger supply of gas for their private customers than at any time within the past three years. In fact, the concern have more gas than their private consumers can use, and recently mailed to Pittsburg manufacturers copies of a circular in which they quote as follows: For the first 500,000 cubic feet or part thereof consumed per month, 15 cents per 1,000; for the second 500,000 cubic feet or part thereof consumed per month, 10 cents per 1,000; for all over 1,000,000 cubic feet consumed per month, 8 cents per 1,000, subject to the conditions and provisions of the regular form of contract.—Iron Age.



1. Car trucks thrown into a culvert at Santa Rita. 2. A freight train wrecked at a Cien Rosas plantation. 3. Fort at Caibarien to protect the railway. 4. A passenger car left curiously poised on the pier of a destroyed bridge. 5. Troops relaying tracks. 6. View of railway track after the wreck.

DIFFICULTIES OF RAILWAY BUSINESS DURING THE WAR IN CUBA.

THE SCABIOUS.

By C. Wolley Dod, in the Gardener's Magazine.

The accompanying illustration represents a white variety of Scabiosa caucasica. This variety came, we believe, accidentally a few years ago from seed in the nursery of Mr. Prichard, of Christchurch, in the unaccountable way in which one plant out of a sowing becomes white when the normal color is blue. It often happens that these albino flowers are of a dull white, and are far from being an improvement on the ordinary color of the species; but this has the merit of being a clear and pure white, and is a welcome novelty, though the soft and pleasing lilac blue of the type will never allow its white rival to supersede it. I have not yet proved how this variety comes from seed, but Mr. W. Thompson, of Ipswich, who is a trustworthy authority on these matters, assures us that a large proportion of the seedlings come true.

SCABIOSA CAUCASICA ALBA.

The species S. caucasica, which is the handsomest and has the largest flowers of the whole genus, was first introduced into English gardens just ninety years ago by those eminent and excellent gardeners, Messrs. Loddiges, of Hackney, whose skill and enterprise in introducing and cultivating hardy plants has never been equaled since their time. It is native of several parts of the Caucasus, and has also been found on that unexhausted treasury of choice hardy plants the region of the lower Amoor River. It is sometimes called var. connata—a superfluous epithet, as the whole species has connate leaves, that is, in pairs joined at the base. In fact, the name connata was given to the species by a Danish botanist about the same time as the name caucasica was sanctioned by botanists generally. The plant was figured and described by Sims in the Botanical Magazine, t. 886, 1806, under the name of S. caucasea. Why was the name changed to caucasica? Both caucasea and caucasia are good classical words, while caucasica is a modern coinage; and the description by Sims in the Botanical Magazine was published several years before Bieberstein, in his "Flora Caucasica," gave the plant its present less correct form of name. It is an excellent border plant, liking full sun and light, rich soil, in which it flowers from the end of June quite on to November. On October 20, after three nights of sharp frost, several clumps in my garden were as full of flowers and buds as they had been at any time during the summer, and the flowers are better in form and fresher in color. A supply is easily raised from seed, which is ripened in abundance, if not eaten prematurely by finches, which are very fond of it. Seedlings flower the second season, and continue in their prime for several years, but I have never found divisions or pieces do well.

Very few other members of the large genus Scabiosa find favor in English gardens. It is hardly needful to mention the well known S. maritima, often called S. atro-purpurea, except to say that though generally said by botanists to be an annual, and cultivated as an annual, it is really perennial; as I have flowered the same plants for two years without their growth being exhausted. The only advantage of keeping the old plants in a frame through the winter being the earlier date at which they begin to flower. The species has a curious viviparous habit; the seeds often sprout and show leaves while still attached to the head. It is a native of the warmest parts of France and Southern Europe, and extends into Western Asia.

The native S. columbaria is a neat and pretty plant to grow on limestone rockeries and chalky soils. White varieties of this may be sometimes found, and are offered in catalogues. I recollect seeing one with very pure white flowers on the face of a rock near Llandudno; but as it could not be reached without the risk of a broken neck, I hope it is there still.

The dwarfest of the genus I have seen in cultivation is S. pterocephala, formerly called Pterocephalus parnassi; a very neat rock plant in habit, three or four inches high, with large flowers of a pale dull blue. Unlike many Greek plants, it is quite hardy. Yellow scabiouses are offered in catalogues, but all of these I have seen have been disappointing, mostly of a dull ochrous color, rather than clear yellow. The coarse plant Cephalaria tabarica also often poses as a scabious under two or three different specific names. But I am far from asserting that, among so large a genus, there may not be many species besides those I have mentioned well worthy of a place in gardens.

The Huxley Memorial.—At a meeting of the Huxley Memorial Committee recently it was reported that the subscriptions now amounted to £1,400, and it was resolved that a wider appeal for subscriptions should now be made. In America committees are being formed to promote the realization of an adequate fund. Besides the statue for the National History Museum, the committee hope to found exhibitions, scholarships and medals for biological research and lectureships, and possibly assist the republication of Mr. Huxley's scientific works. The treasurer is Sir John Lubbock, 15 Lombard Street, E. C., London.

THE PRESENT STANDING OF THE FLORIDA MANATEE, TRICHECHUS LATIROSTRIS (HARLAN), IN THE INDIAN RIVER WATERS.

By Outram Bangs, in the American Naturalist.

The last two generations have witnessed such a destruction of animal life in this country that it is appalling to look ahead and see what the future has in store for us. Our larger animals and birds are going with such rapidity, and the wilder parts of the country to which they have been driven are being cleared and settled so fast, that the end of many species still common in places is already plainly in sight.

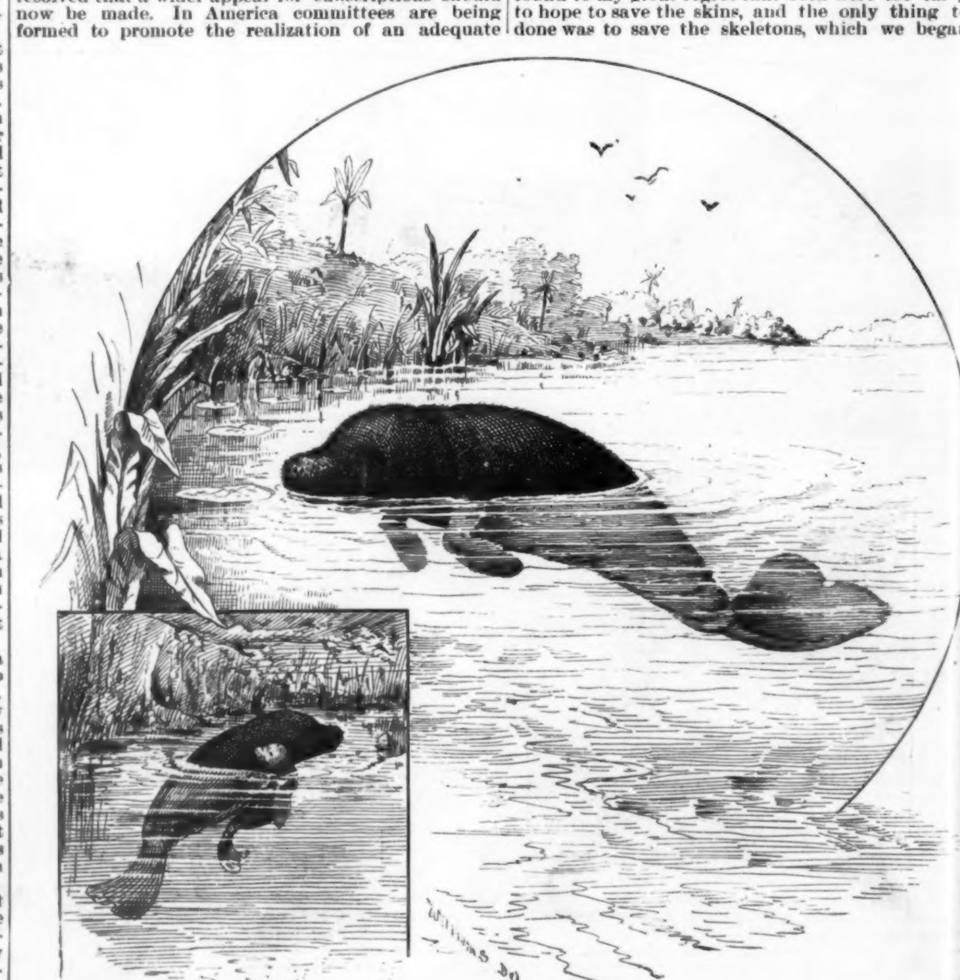
Man is, of course, the real cause in almost every case of the extermination of a species, although often the end comes by some natural calamity, as, for example, the tragic end of the great auk.

When a species has become, through the persecution of man, reduced to a mere remnant that persists either from the inaccessible nature of the country to which it has taken refuge, or from the wariness the few surviving individuals have developed, it takes but a small change in its surroundings to wipe it forever from the face of the earth.

The winter of 1894–1895 has been a most disastrous one, and has shown us on how slight a change in temperature the life or death of a whole species depends. Two such winters in succession would in all probability exterminate the bluebird, the snowbird and many others that winter in the Carolinian zone. These birds went into the winter in their full numbers and strength, and yet last summer they were so rare that I did not see a single bluebird in the Plymouth County, Massachusetts, country, where usually they are one of the common breeding birds. Think what a proportionate reduction in numbers must mean then to a species already on the verge of extinction!

The cold in Florida of the last winter was unprecedented, and the mortality among the fish in the shallow water was such as I never thought to witness. The birds suffered very much, but as far as I could tell few died as far south as where I was, Oak Lodge, on the East Peninsula, opposite Micco. Here at five o'clock on the morning of February 12 the thermometer registered 20° Fah., and on the next morning at the same hour only 23°. It was a strange experience to walk over the frozen sand and see every little puddle covered with ice on a trail overhung by the subtropical vegetation of a Florida hummock with a north wind blowing in my face that chilled me to the bones. The cold of these two days and nights was intense.

On February 19 Mr. Walter L Gibson came across the river to tell me he had found two manatee that had been killed by the "freeze," and the next day I went over to take possession of them. They were both found where they had floated ashore on the bank of the Sebastian River, one about four and the other two miles from its confluence with the Indian River. I found to my great regret that both were too far gone to hope to save the skins, and the only thing to be done was to save the skeletons, which we began to



THE MANATEE, OR SEA COW.

macerate out at once. One was an old female of very large size, measuring from the end of the nose to the end of the tail 11 ft. 4 in. The other, a young male, measuring from the end of the nose to the end of the tail 6 ft. 4 in.* Both skeletons are now in the collection of E. A. and O. Bangs, Boston, Mass.

These manatee were two of the survivors of the herd of eight which had, for the past year, been living in the St. Lucie and Sebastian Rivers and that part of the Indian River which is between these two. For two years the manatee has been protected by a State law, and this herd had come together in consequence and probably consisted of most of the manatee of this region that, freed from persecution, had collected into a herd as was their wont in old times when the rivers were theirs.

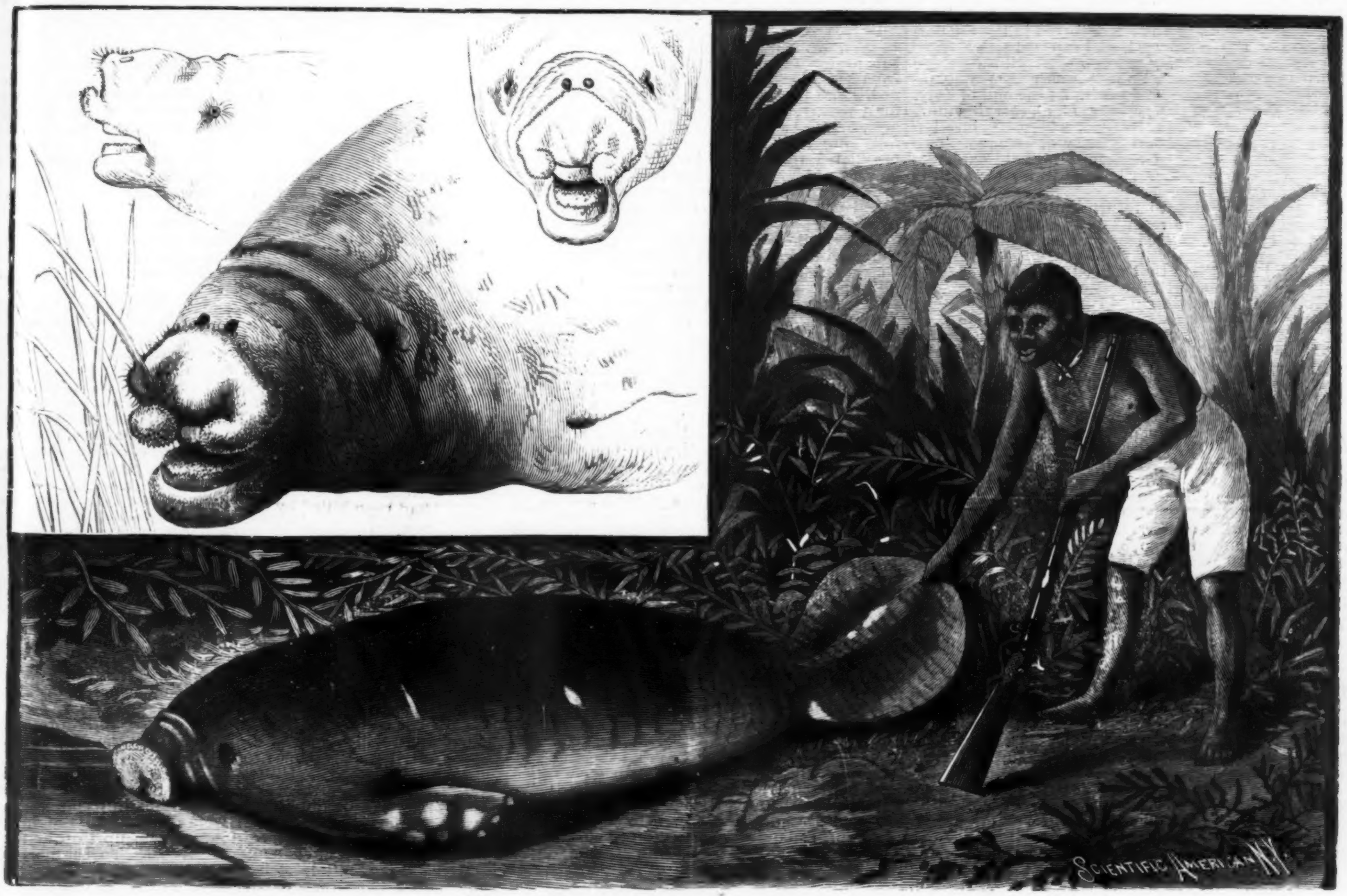
Mr. Gibson told me that often he has stood on the railroad bridge that spans the Sebastian, and seen this herd pass under him and counted them over and oven again and knew every individual in it. After the first "freeze" of last winter, in December, three of the manatee were found ashore, dead, in different places, and no live ones were seen. Whether any of this herd pulled through both "freezes" is impossible to say, but five out of the eight are accounted for, and it seems likely that more died than were found, as a great part of their range was not covered and their carcasses might easily have escaped detection even in places that were visited. It does not take long for a dead body to disappear in Florida, and the manatee, as they lay half under water, would soon have been disposed of, the crabs doing the business below the surface and the turkey buzzards above.

they heard him they made a rush for deep water, throwing the mud and water fifteen feet high in the violence of their flight.

I made many careful inquiries among the people who live along the river and would be in the way of knowing of the manatee and its diminution of numbers of late years, but got surprisingly little information of any value except from Mr. Gibson, to whom I have so often referred, and Mr. Fritz Ulrich, a German of more than ordinary intelligence, who has spent the last fifteen years dreaming his life away among the birds and animals of the Indian River. They were all his friends. The panthers knew his voice and answered him from the wilderness, and the owls came from their hiding places and flew about him to his call and the little lizards fed from his hand.

But it is all gone now and there only remains of the great life of the river a small terrified remnant, and in its stead the railroad train hurries along the west bank, and hideous towns and more hideous hotels and cottages have sprung up everywhere among the pines. It is now eight years since Mr. Ulrich saw a living manatee, but when he first came to the river fifteen years ago they were still common and he often saw them from the door of his little house at the Narrows passing up and down the river, and occasionally he saw them at play, when they would roll up, one behind the other, like the coils of a great sea serpent.

The spring and summer of 1894 were so dry that the salt water went nearly to the head of the fresh water streams and killed out the "manatee



THE FLORIDA MANATEE.

grass," of which the manatee are especially fond, and the poor brutes had to fall back on the leaves of the mangroves, a food not much to their liking, which they reach by laboriously dragging their huge bodies half out of water. Mr. Gibson spent a great part of that summer up the Sebastian, where he was catching paraquets, and on several occasions he saw the herd of eight feeding in this manner.

The manatee is extremely sensitive to a change in the temperature of the water. This was noticed by Mr. Conklin to be the case with the one that was kept alive in the Zoological Park in New York, and Mr. C. J. Maynard told me that he knew of three large manatee that were killed in the "freeze" of 1886 and washed up near Palm Beach. The 1886 "freeze" was very mild compared with those of last winter. In 1886 the mangroves hardly suffered at all, while last winter, 1894 and 1895, nearly every tree along the whole stretch of the Indian River was killed to the ground.

In both "freezes" last winter the cold came without any warning and the change of temperature was so sudden that the only chance for the manitee to escape certain death lay in their being able to reach deep water before they were overcome by the cold.

The region from the Sebastian to the St. Lucie has, for a number of years, been the only part of the Indian River where the manatee were seen. Here, besides the herd of eight, now reduced to three at the very outside, there were some solitary scattering individuals, how many it is impossible to say, as the manatee has become very shy, but it is safe to assume that the scattering ones fared no better than did the herd, and that the reduction in numbers from the cold of last winter was very great.

There are still, however, a few manatee alive in the Sebastian River. In a letter I lately received from Mr. Gibson he told me that in the end of March he surprised several manatee lying close together on a mud flat, high up the Sebastian River. As soon as

* The Florida manatee grows but little larger than this female. The two largest I ever heard of were two caught in the St. Lucie River by Mr. August Park, of Sebastian, Florida. One in August, 1880, that measured 18 ft. 7 in. long, and one in June of the same year that measured 12 ft. long and estimated at 2,000 lb. weight.

The manatee is an animal of the highest economic value and one that the Indian River, with its fresh water tributaries, seems able to support in large numbers, and it would be more than mere sentiment to regret its disappearance should it become a thing of the past. But there is still a chance for it.

There are some manatee alive now in the Sebastian River and these have passed through the cold of a winter such as no living man in Florida has known before; they are protected by law, and the netting has been stopped; and in spite of the small annual increase, the female bringing forth but one calf a year, it should slowly come up again to something like its old numbers.

ARCTIC EXPLORATIONS IN 1894–1895.*

By CHARLES RABOT.

LAST year I called attention to an important resumption of arctic exploration. In order to extend their researches, three expeditions passed the winter of 1894–1895 in the polar regions—that of Lieut. Peary, in Northern Greenland; the Jackson Mission, in Francis Joseph Land; and the expedition of Martin Ekroll, the Norwegian, in eastern Spitzbergen.

The results obtained by Lieut. Peary are so well known that it is unnecessary to revert to them. Before presenting a summary of Mr. Jackson's explorations in Francis Joseph Land, it seems well to us to recall the conditions of navigation in these quarters in order that the importance of the new enterprise may be judged of understandingly.

In 1873 Messrs. Payer and Weyprecht discovered this land under dramatic conditions that no one has forgotten. Their ship, frozen to a thick ice pack which a slow current was carrying toward the north, came in sight of an unknown archipelago to which the explorers gave the name of their sovereign. In the following spring, Mr. Payer, with an energy that no obstacle could conquer, undertook a reconnaissance of Francis Joseph Land. After this memorable voyage, the expedition retreated, leaving its ship imprisoned in ice.

The Austro-Hungarian Mission had found the approaches to the new archipelago barred by large ice floes, and for several years these islands were considered as inaccessible.

In 1879, however, Commander (now Admiral) Markham succeeded in getting a view of these lands with a small and heavy sailer. In the following year, Mr. Leigh Smith, the celebrated explorer of Spitzbergen, was still more fortunate. Not only did he easily reach Francis Joseph Land, but also, meeting with open water in the region that the Austro-Hungarian expedition had found obstructed by formidable fields of ice, visited a portion of the archipelago. The following year Mr. Leigh Smith met with the same favorable conditions. He was arrested in his success only by the loss of his ship, due to one of those accidents that are unfortunately too frequent in the navigation of the polar seas. The situation was grave; the expedition had not been organized with a view to going into winter quarters, provisions were lacking and the season was too far advanced to effect a retreat. Under such conditions, the crew passed the winter in a hut constructed with the wreckage of the ship and, for six months, lived upon the products of the chase. Fortunately, moose and bears abounded around the station, and despite the rigors of an arctic winter, no one was sick.

These two voyages were prolific in results. Not only did they increase our geographical knowledge in a large measure, but also, contrary to the observations of the Payer expedition, proved the relative ease of access to Francis Joseph Land by standing for the north, between the 45th and 55th degrees of longitude east of Greenwich. Mr. Smith found that a breaking up of the ice soon takes place around this archipelago, and that the presence of numerous bears and moose upon this land assures the revictualing of an expedition. Francis Joseph Land was therefore recognized by the English arctic explorers as the most favorable starting point for a future polar exploration. But, as says Mr. Montefiore, from whom we borrow these data, since Africa absorbed all attention, to the detriment of the arctic regions, nothing was attempted in this direction.

In 1893, Mr. F. G. Jackson, a young Englishman who had already undertaken several voyages to the north, published a plan of polar exploration which had Francis Joseph Land as its base of operations. In England, as in Scandinavian countries, the rich classes make it a point of honor to aid explorers with a liberal hand, and, thanks to the munificence of Mr. Harmsworth, Mr. Jackson was enabled to put his project into execution.

On July 12, 1894, the expedition set sail on the whale

* Communication made to the Paris Geographical Society.

ship Windward, purchased by Mr. Harmsworth, and, finally, on September, 7, reached Bell Island, which is situated at the southern extremity of Francis Joseph Land, after having its progress interfered with by large ice floes. According to the plan of the voyage, Mr. Jackson and his seven companions were to establish a station which should serve them as a starting point for their exploration toward the north. Shelters having been constructed, the vessel was to return to England. This programme could not be carried out. During the construction of the buildings and the unshipping of the provisions, winter suddenly set in and on September 13 a thick layer of new ice forced the Windward to go into winter quarters. By means of ponies harnessed to sleds, Mr. Jackson undertook several expeditions in the spring. His observations introduce important modifications into the topography of the archipelago. In the first place, Zichy Land does not exist. On its supposed site there is simply a chain of islands that separate Austria Sound from a second channel situated more to the north. In the second place, Alexandria Land, instead of forming a continental mass, constitutes an archipelago.

According to Mr. Jackson's experience, sledges drawn by ponies are very practical for traveling toward the north in the region of Francis Joseph Land. As the breaking up of the ice takes place very soon in these quarters, vehicles of this kind can, it is true, be employed only during winter, before the end of April. In our opinion, Shetland ponies might render great services in arctic lands, and, for an exploration of the interior of Spitzbergen in summer, we could not too strongly advise the use of them.

In the wake of a storm from the east that lasted five days, a breaking up of the ice occurred in the anchoring place of the Windward, and exposed the ship to the greatest danger. By the end of April the ice floe in Austria and Markham Sounds was rotten and unapproachable by the excursionists. At the end of July, the Windward left Francis Joseph Land, carrying news of the expedition which Mr. Montefiore has just imparted to the Geographical Society of London. Two days after the starting of the ship, the bold explorers were obliged to put themselves en route toward the extreme north.

Mr. Jackson is not to return until the end of the summer of 1896. The results that he has already obtained are a certain pledge of a final important success.

The third expedition that passed the winter of 1894–1895 in the extreme north is that of the Martin Ekroll, the Norwegian, starting upon the schooner William Barentz. It steered along the coast of Norway, toward Hope Island, which is doubled at the south. According to Ekroll's observations, this land of eastern Spitzbergen is of greater extent than the maps make it. Its length is 22 miles, and not 13, as the most recent documents have it. Apart from a sandy point a mile wide, upon the northern coast, Hope Island consists of a plateau of from 65 to 130 feet elevation.

From Hope Island Mr. Ekroll reached the Anderson Islands, situated to the west of Barentz Island. A hut was erected upon this archipelago, and four men were landed, with instructions to hunt in the neighboring region during the winter. The expedition afterward returned to the south to establish itself in winter quarters at an anchorage place near Whales Point. This port, which is not put down on the maps, and which, in Mr. Ekroll's opinion, is one of the best of Spitzbergen, is situated in 77° 36′ of north latitude and in 20° 59′ longitude east of Greenwich.

During the course of the fall, the expedition explored Deevie Bay.

To the east of Edge and Barentz Islands the sea at this epoch was almost completely free, and in Mr. Ekroll's opinion it would have been easy at this season to reach the eastern coast of Northeast Land. Up to the end of September, no other ice was seen in this region than that formed upon the calm surface of the fjords.

During the winter, the field of ice frequently opened in the Storfjord and round the Thousand Islands. Several times, even, in the vicinity of this archipelago, it drifted further than the eye could reach. To the east there almost always extended a sheet of more or less open water.

The temperature descended several times to —40°. The prevailing wind was that of the northeast. The breezes from the southeast had the characters of the fœhn, and the abrupt rise of the thermometer that they brought about regularly induced in the explorers an ailment that exhibited the symptoms of malaria. As soon as the wind ascended toward the north and the temperature descended again, this indisposition at once ceased.

All the striæ scratched upon the islands and upon reefs of the Storfjord by floating ice are directed toward the mouth of this large bay, and, consequently, indicate a general drift motion of the ice floe toward the south. In this fjord the current, on the contrary, tends toward the north. The motions of the ice are, therefore, determined principally by the prevailing northeast wind. A portion of the floating ice in eastern Spitzbergen must come from the Kara Sea.

According to Mr. Ekroll, the glaciers of Spitzbergen —those of eastern Spitzbergen especially—are at present receding. The phase of decrease, pointed out by Heuglin, in 1870, upon the frozen currents of this region, therefore still continues. In July, 1895, the expedition left its winter quarters, and, after rallying the men left upon Anderson Island, steered toward the northern coast of Spitzbergen. In this region, thick ice packs had been heaped up by the persistent western winds. Under such circumstances, Mr. Ekroll retreated toward the south, and doubling the southern extremity of Spitzbergen, re-entered the Storfjord. Here again the ice was wanting in compactness. At the end of August a large ice floe extended in the west of Edge Land, almost completely closing the entrance to the bay. Along the coast of Spitzbergen there opened only a narrow channel of free water.

Up to this time no expedition had wintered in eastern Spitzbergen. The meteorological and hydrographic observations made by Mr. Ekroll are therefore of extreme importance. In conclusion, let us remark that this expedition succeeded in killing the immense number of 68 white bears.

Mr. Ekroll's remarks upon the position of the ice in eastern Spitzbergen in the summer of 1894 form a new argument in support of the project for an exploration of the arctic regions situated to the north of Europe that I developed last year before the Geographical Society.

You know how things are done at present. Some fine day an explorer conceives the idea of studying this or that region. He starts, and he meets with ice floes upon his route. He nevertheless endeavors to push forward, and, as no ship is powerful enough to form a passage for itself through the ice by live force, his vessel is finally blocked or sunk, or at least reduced to inaction. A large amount of effort and money is thus entirely lost.

In my opinion, in order to obtain results to some degree certain around Spitzbergen, Nova Zembla and Francis Joseph Land, expeditions should set out without any fixed destination. In certain years the ice remains agglomerated upon the northern coast of Spitzbergen and between Nova Zembla and Francis Joseph Land, leaving the sea very free in the east of Spitzbergen. In other seasons, on the contrary, the ice floes have an inverse geographical distribution. The coast of Spitzbergen is found free very far toward the north and northeast, access to Francis Joseph Land becomes relatively easy, and, during this time, eastern Spitzbergen is blockaded by ice. Instead of trying, at no matter what cost, to reach a land determined upon in advance, arctic expeditions should simply seek a zone of open water, and, after discovering it, work in such region. The most skillful Norwegian seal hunters do not proceed otherwise, and everyone knows the importance of the geographical discoveries made in the arctic regions by these humble sailors.

In this regard, experience is particularly instructive. In 1872, Mr. Nordenskjold set out for Spitzbergen with the design of pushing toward the pole in starting from the Seven Islands. Stopped by the ice, the expedition was unable to reach the Seven Islands, and, for a year, remained exposed to the most terrible dangers. At the same epoch, Mr. Payer, who was in the following year to discover Francis Joseph Land, was blockaded by the ice in a very low latitude before Nova Zembla, and, during this time, the Norwegian fishermen, finding the sea open in eastern Spitzbergen, sailed tranquilly around King Charles Land in their nutshells.

In 1894, the ice had the same geographical distribution. In trying to reach the Seven Islands, the ship of the American Wellman expedition was sunk by the ice floe, and it was only at the cost of the most strenuous efforts that Mr. Jackson was enabled to proceed toward Francis Joseph Land. At the same epoch, on the contrary, the sea was as in 1872, very free in eastern Spitzbergen. Had Mr. Ekroll had a steamer at his disposal, like his American and English colleagues, there is no doubt that he would have made discoveries of the highest importance.

I must now speak to you of expeditions directed toward regions less northerly than Spitzbergen, but which have obtained important scientific results.

Last winter, the Danish government, always solicitous for the progress of the sciences, decided to undertake for two summers an exploration of the great depths in the seas of Greenland. The Ingolf, a cruiser of the Danish navy, was selected for this service, and her commander, Mr. Wandel, whose professional ability equals his extreme scientific competency, was placed at the head of the expedition. In addition to three naval officers and a surgeon, the mission included three zoologists, Messrs. Jorgensen, Handsen and Lundbeck, one botanist, Mr. Ostenfeld Hansen, and one chemist, Mr. Knudsen.

The expedition left Copenhagen May 2, destined for the Faröe Islands. Between the Lindesnas and this archipelago observations were made upon the temperature and density at the surface of the sea, in going as well as in returning, in order to continue the hydrographic studies that had been pursued in this region for several years by England and the different Scandinavian countries. The mission made a series of deep sea thermometric observations and dredgings upon a straight line running from the Myggesnas (the most westerly island of the Faröe) to the Seydisfjord (east coast of Iceland). Arrested by the ice in his progress toward the north of Iceland, Commander Wandel steered toward the strait of Denmark by the south of the island. Here he was no more fortunate, since storms from the northeast prevented the expedition from pursuing its researches for more than a month.

The Ingolf reached Godthaab in Greenland on June 26. From Iceland to Greenland, favored by fine weather, work was carried on almost uninterruptedly. Unfortunately, there soon afterward supervened a new period of storms, with fogs, accompanied with an abnormal lowering of the temperature. At the same time, the ice floes interfered with the progress of the vessel. This year, the vest-is (" western ice "), an ice floe drifting toward the south along the American coast under the impulsion of the Labrador current, presented an abnormal extension toward the west. To the north of Holsteinborg it extended as far as to the coast of Greenland, thus completely barring Davis Strait. Rightly estimating that it would be imprudent to pass an iron ship like the Ingolf through such a mass of ice, Commander Wandel abandoned the project of pushing farther to the north and visiting Disko Bay. In the south, the ice was no less compact. The stor-is (ice floe from the east coast moving to the northwest) extended as far as to the latitude of Godthaab. On the return from Cape Farewell to the Faröes, work was again almost the whole time interrupted by storms. On August 22 the ship reached Copenhagen.

Although interfered with by bad weather, the expedition nevertheless brought home an ample store of scientific observations of the highest value, thanks to the energy and devotion of the commander and all the members of the mission. Series of soundings and measurements of deep sea temperatures were made and numerous specimens of water were collected. The greatest depth reached by the sounding line and the trawl in this campaign exceeded 10,000 feet. The zoological collections were likewise very abundant. The naturalists gathered very complete material for the study of the Plankton and large collections of the abyssal fauna. They ascertained that some corals, some crustaceans and even a few species of fish that have hitherto been known only from much more southerly latitudes (from the Antilles to the coast of New England) advance very far to the north in following the great ocean depressions. The results of these hydrographic and zoological studies will be published in a large work that will constitute a valuable document upon the marine fauna and its geographical distribution in the north.

The storms so frequent in the northern Atlantic last summer were the cause of several catastrophes. Two Danish transports doing service for the colonies were wrecked. The Hvidbjorn, the powerful steamer upon which I made my trip to Greenland was sunk, and a large sailer was cast upon the coast in the very port of Julianehaab.

The Danish government, nevertheless, succeeded in revictualing the station of Angmagsalik, established in 1894, upon the eastern coast of Greenland, by Commander Holm.

This mission was confided to the Norwegian steamer Hertha, commanded by Capt. Jorgensen. Leaving Copenhagen on August 14, this vessel reached Angmagsalik eleven days later and returned thence on August 29, bringing news of the little colony.

During the winter of 1894–1895 the latest temperature observed at the station was —22°. This was on January 17. A few days afterward, on February 1, under the influence of an eastern storm, the temperature rose to +3°. The very variable climate exerts a pernicious influence upon the small tribe of Eskimo established in these quarters. An epidemic of influenza that broke out in 1892–1893 carried off an eighth of the effective force of this tribe, say fifty persons.

The Danes were informed by the Eskimo that in the month of July they had seen a three masted vessel caught in the ice. This news brought by the Hertha seemed to make probable an early return of Mr. Nansen. The ship of this celebrated explorer, in fact, carries three masts, and the bold Norwegian had the intention of effecting his return in following the ice floe of eastern Greenland. Some months have since passed, and as yet we have no news of Mr. Nansen. The information given by the Eskimo must, however, be accepted only with the greatest caution. Although inhabiting the extreme north, these aborigines have an extremely southern imagination. In the opinion of Lieutenant Garde, of the Danish navy, to whom long expeditions to Greenland have given a profound knowledge of the character of the natives, the vessel that the Eskimo got a glimpse of was purely imaginary and simply some pointed iceberg transformed into a ship by the imagination of these Indians or by a mirage.

The observations made by the members of the Angmagsalik mission and the captain of the Hertha are very important as concerns a knowledge of the movements of the ice in eastern Greenland. From the first days of September to the end of November, 1894, the coast remained completely free opposite Angmagsalik. In 1884, at the time of Commander Holm's going into winter quarters in this same locality, no ice was visible during this period either. On the contrary, from December, 1894, to the middle of June, 1895, a great ice floe extended further than the sight could reach in front of the coast. Toward the middle of June it began to break up along the shore, and by the end of July was sufficiently divided to permit of the passage of a ship. In the latter part of August the Hertha met with but few fields of ice, and these were not very thick and lacked consistency.

In Capt. Jorgensen's opinion, a ship would, in autumn, have to land at some point or other of the eastern coast of Greenland to the south of the polar circle.

Upon comparing this observation with those of Mr. Ekroll upon the state of the glaciers around Spitzbergen and of Commander Wandel in Davis Strait, it will be seen that this year a zone of open water was found off eastern Greenland.

According to the statement of Capt. Jorgensen, Blosseville Land is put down upon the maps thirty marine miles too far to the north.

Mr. Thoroddsen, always persevering and one of the laureates of the Geographical Society of Paris, has pursued his important explorations in Iceland. Last summer his researches were directed to the northeastern region of the island, which, up to that time, had been visited by no naturalist. To the north of Myvatn and in Melrakkasletta this traveler discovered important chains of craters. Melrakkasletta, formed of preglacial lava, resting to the south upon a mass of palogonite, is cut up by great volcanic crevasses several dozens of miles in length. In this region there are likewise several lakes that have remained up to the present unknown.

The greater part of the promontory of Langanas is formed of beds of dolerite, and upon the southern face Mr. Thoroddsen found the eastern limit of the great palagonitic formation that occupies the center of Iceland and serves as a substratum to the majority of the volcanoes of the island. The extension of this formation, so far toward the east, had remained unknown.

The map made by Mr. Thoroddsen in the course of this new voyage introduces numerous rectifications into the topography of the island. At the same time, its geological survey fills an important gap in our knowledge of the formations of this country.

To the south of Iceland, in the Archipelago of the Faröes, the Danish government has just undertaken some important geographical work. The present maps of this group of islands are very incomplete and inaccurate, and the position that they give to the Archipelago is even very erroneous. In order to remedy this state of things, the Danish staff office undertook the triangulation of the Faröes last summer, and in a few years will be in a position to publish an accurate and detailed map of these interesting islands.

Upon the whole, we have this year to record none of those great polar expeditions that remain forever celebrated; but all the explorations undertaken have brought home an ample store of important observations of every nature.

MR. C. E. BORCHGREVINK has sent the whole of his mineralogical collection from South Victoria continent to Dr. John Murray, F.R.S. Mr. Borchgrevink holds that his specimens are especially valuable as proving "the land round the axis of rotation in the south to be a continent."

ENGINEERING NOTES.

WHAT is probably the largest boiler of the locomotive type ever built was recently designed by Mr. F. W. Dean, mechanical engineer, of Boston. The boiler is 10 feet in diameter, has two corrugated furnaces, and has 5,300 square feet of heating surface.

THE United States is claimed to put coal on the market at a lower figure than any country in the world. The census of 1890 showed that the average price of bituminous coal was for 1889, 99 cents per ton. The present price at the Pennsylvania mines is 65 cents per ton; and it costs at the mines in Illinois something less than one dollar.

AN attempt is being made at Santa Cruz, California, to utilize the head of water obtainable by the rise and fall of the tides for supplying the town with light and power. Engineers have long been aware of the great energy that is at work in the ebb and flow of the tide, and have realized that if it could in some way be controlled, it would give all the horse power necessary for the needs of sea coast cities.

A $20,000 dynamo is being erected at Santa Cruz, and the head of water obtained at high tide is to be utilized to drive it.

THE amount of new railway built in the United States in 1887 was 12,983 miles. The amount built in 1895 was 1,782 miles. The difference is 11,201 miles. At $20,000 a mile this is $224,020,000; which represents roughly the amount paid out for the construction (which is chiefly labor) in 1887 in excess of the amount paid out in 1895, and $224,020,000 is a dollar and a half a day (Sundays and all) for a year for 409,543 men. That represents the difference to labor, in railway building alone, between a year of boom and a year of hard times.—Railway Age.

THE Yarrow Torpedo Boat Destroyers.—The Russian government propose to adopt Messrs. Yarrow's plans for the construction in Russia of a large number of torpedo boat destroyers similar to the 29 knot boat Sokol, recently built for them on the Thames, and illustrated in the issue of the SCIENTIFIC AMERICAN of November 6, 1895. The construction of the vessels will be under the superintendence of Mr. Yarrow, who, it is understood, has been offered liberal terms, and they will be fitted with the Yarrow type of water tube boiler. The Argentine government has also placed an order with Messrs. Yarrow for four boats of the Sokol type, to attain a speed of 30 knots.

SOME interesting details are given in the Railway Review of the means adopted for the transportation of what is claimed to be one of the largest ship stern frames ever built in this country. The forging, manufactured by the Paterson Iron Company, of Paterson, N. J., was 21 feet 2 inches wide by 28 feet 10 inches long, and weighed 26,000 pounds. The great width necessitated the use of both tracks for the journey to the docks at Jersey City. The main part of the forging, which was rectangular and about 12 feet wide, was placed upon an improvised turntable on the deck of a flat car, and this enabled the projecting arm of the frame to be swung around to clear signal posts, etc. A special engine and crew conveyed the piece to the docks in about three hours.

A LARGE ferry steamer, which, it is claimed, will be the most powerfully constructed vessel on the lakes, is being built for car ferry service between Ludington and Manitowoc. The principal dimensions are as follows: Length over all, 350 feet; between perpendiculars, 331 feet; beam, 56 feet; depth below main deck, 19·5 feet; depth from upper deck to floor, 37 feet; draught not to exceed 13 feet when carrying 30 loaded cars and 200 tons of coal. Four boilers, each 13½ feet in diameter and 12 feet long, will furnish steam for three fore and aft compound engines of equal power, with cylinders of 24 and 48 inches in diameter and 36 inch stroke.

The bow screw is 9½ feet in diameter and the stern screws are 11 feet; and each is driven by a separate engine. To resist the shock of the ice, the bow will be plated with ¾ inch plates for a length of 30 feet and for 3 feet above the water line.

AN exhaustive report by Captain Glass, on the battle ship Texas, has been forwarded to the House Committee on Naval Affairs, at the close of which he says: "In concluding this report I beg leave to say that when the palpable defects in structural arrangements and machinery have been remedied, the Texas will be, in my opinion, one of the most efficient ships of her class afloat. Her high speed, almost perfect maneuvering power and great steadiness, make her an ideal vessel at sea, and she will be found an admirable gun platform. Her heavy armor is well placed, and the vital points of the ship are thoroughly protected. The battery carried, which admits of concentrating a heavy fire in many directions, would make her most formidable in action. She possesses ample berthing space for the health and comfort of even a larger complement of men than now carried, and has facilities for stowing stores and provisions."

Mr. J. H. MCCONNELL in a recent paper before the Western Railroad Club, made some interesting comparisons of rolling stock of to-day and of twenty-five years ago. At that time a large portion of the traffic was handled by 16 by 24 inch cylinder locomotives, and the maximum load for a freight car was 20,000 pounds. To-day cars of 60,000 pounds capacity are common, and sometimes they reach 80,000 pounds. The latest refrigerator cars when fully loaded weigh as high as 100,000 pounds. The early cars carried 300 bushels of grain; the modern cars carry 1 000 bushels. The early sleeping car weighed 60,000 pounds; the modern sleeper weighs 100,000 pounds. The 30 ton engine has grown to weigh 60 tons; the ten wheel engine has increased from 45 tons to 90 tons; and the consolidation from 50 to 80 tons. An 1870 engine weighing 100 000 pounds, and carrying 140 pounds of steam, hauled 24 loads, weighing 528 tons; the 1895 engine weighs 150,000 pounds, carries 180 pounds steam pressure, and hauls 85 loads weighing 1,120 tons over the same division. Twenty-five years ago, with a time schedule of 22 miles an hour, it would have been considered an impossibility to make an engine haul 10 cars on a schedule of 40 miles an hour; yet it is now done every day, and these engines maintain a speed of 55 miles per hour between stations, with 10 cars.

ELECTRICAL NOTES.

THE Simmering Wagon Company, Vienna, are building an electrically operated turntable for the Austrian State Railways.

THE use of electric traction on the street railways of the United States is now almost universal. Out of a total of 13,176 miles, 10,238 miles are run by electric power.

SOME idea of the vast field covered by the electrical industry may be gained from the catalogue of the General Electric Company. There are close upon 1,000 quarto pages in the catalogue. The illustrations cover almost every practical application of the new industry.

AN exhibition has recently been made in Philadelphia of a method of telegraphy which, it is claimed, doubles the capacity of a single wire. The device makes use of the light produced in a vacuum by currents of high frequency and low intensity. Two operators work on the same wire, one using the usual Morse instrument, while the other uses the above mentioned light.

THE Milwaukee Street Railway shows some remarkable statistics of operation for the year 1895:

Average number of cars per day	165
Mileage	7,000,000
Passengers carried	28,000 000
Coal consumption (tons)	30,000
Wages bill	$750,000

THE city of Richmond, Va., the first to adopt electric traction, is the first also to enact municipal legislation aiming to prevent electrolysis of gas and water pipes. At a recent meeting of the city council an ordinance was passed for this purpose.

The ordinance provides that the rails of street railways in that city shall either be electrically welded or, if separate, shall be bonded at each joint with copper bonds of appropriate cross section.—Electricity.

ARRANGEMENTS have been perfected by which the Metropolitan Telephone and Telegraph Company, of New York, by the aid of the Weather Bureau, will transmit information regarding weather forecasts to the general public. Any one may hereafter call for answers to special questions at any time and be sure of an answer at once. Any subscriber who wishes to have all important weather news can send his name to the telephone company, and he will thereafter be telephoned by them whenever any marked change is expected.—Science.

ELECTRICITY is of the opinion that the storage battery industry, and to a less extent the whole electrical industry, has been injured by unrealizable claims made from time to time by storage battery promoters and by "applications of the device in situations in which it was physically, chemically, electrically, and mechanically unsuited." The same journal claims that the usual 7 to 10 hour discharge battery is often applied outside of its true sphere of usefulness, and in locations where a 1½ to 3 hour discharge battery, if attainable, would give ideal results.

THE success of electrically welded rails was discussed by Mr. Robert McCulloch in a paper before the Engineers' Club of St. Louis. Some 3¼ miles of double track in St. Louis had been connected up with electrically welded joints. Out of a total of 2,203 joints thus treated, 3·27 per cent., or 72, have parted. The fractures occurred in two successive cold snaps of last winter. Repairs were made by casting a mass of iron around the joint. The amount of opening at the fracture varied from two inches to practically nothing. Strange to say, the heat of the following summer caused very little variation in the width of the openings.

THE Marseilles Street Railway Company reports that one of its cars has recently run 21,935 miles without a single accident to its electric equipment. This record was made between January 24 and September 15, 1895. During this time it was at the repair shop three days, owing to an accident to the car body, and one day for the repair of the hand brake. The average distance covered per day was 96 miles, the maximum 129 miles; the total number of passengers carried during this time was about 215,000. The car is equipped with two 18 horse power Oerlikon motors, type E Z. Another car has recently covered more than 10,000 miles without any repairs whatever.—Street Railway Journal.

REPLYING to a correspondent's inquiry regarding the proper distance between trolley railway tracks, the Street Railway Journal says: "The width of cars varies so much between belt rails that there is nothing which may be called 'standard practice.' A good average distance between gage lines of inside rails is 5½ ft. where no center pole is used, and 6 ft. should be allowed with center poles. This is the distance used on Niagara Street, in Buffalo, which has center poles. On the Broadway line in New York (cable system) the distance has been reduced to 5 ft. An attempt was made in Newark to use center poles with inside rails only 4½ ft. apart, but there was danger of passengers hitting heads and elbows against the poles and they were abolished."

IN the course of a paper read before the Chicago Electrical Association, Mr. J. R. Cravath, the author, stated that the success of the closed conduit system in Buda-Pesth, New York and Washington was, in a measure, due to the fact that the streets on which it is laid down are wide and clean and the traffic is light. Speaking of Chicago, he says: "For the benefit of those who have not observed the conditions of our streets at certain times of the year, I will explain how snow, ice, water, heavy traffic and level streets combine to make a state of affairs very uncomfortable for the operators of a conduit system. After heavy snowfalls there is generally a large amount of snow which does not get cleaned away immediately. In a crowded street a great quantity gets packed down hard and ultimately forms ice in such places, preventing drainage. Then another snowfall, followed by a thaw and perhaps a rain, puts an amount of water in the street that often nearly fills the cable conduit in places. I think it is plain that in view of these facts an open electric conduit road would not be very successful in this city or in many cities where the conditions are similar."

MISCELLANEOUS NOTES.

To overcome the difficulty of obtaining instruments that will satisfactorily indicate rapid variations of temperature in meteorological observations Herr Paul Czermak, of Graz, has made use of thermo-elements with very fine wires. For the desired purpose these are found to be superior to thermometers with platinum bulbs, and much superior to glass bulb thermometers.

To Detect Iron from Steel Tools.—A Belgian journal says: To make the distinction quickly between steel and iron tools, place the tool upon a stone, and drop upon it some diluted nitric acid (four parts of water to one of acid). If the tool remains clean, it is of iron; if of steel, it will show a black spot where touched with the acid. These spots can be easily rubbed off.

A FRENCH process for preventing rust on steel and iron is said to produce a bluish coating, which does not crack or peel off, even if the metal be bent through an angle of 45°. The articles are subjected to a heat of 650° Centigrade in a gas retort for twenty minutes, and then hydrogen is turned on for another three-quarters of an hour. This is followed by the introduction of a small amount of naphtha for a period of ten minutes; after which the hydrogen is again admitted for a quarter of an hour. The retorts are allowed to cool down to 400° Centigrade, and the articles are removed.

A NEW safety cartridge for mines where the flame of the explosive is dangerous is in use at the collieries at Polish Ostrau, in Austria. A quicklime and a dynamite cartridge are connected, so that the lime in slaking heats a primer sufficiently to fire off the detonator embedded in the dynamite. The compound cartridge is inclosed in a bag of loose cotton, woven like a wick. The experiments were made in a gallery containing 7 per cent. of methane and a great deal of coal dust that was kept in motion, and in no case did the cartridge fire the gases or the dust. The flame is confined to the interior of the cartridge, and is stopped both by the slaked lime and the water in the bore hole at its upper end.

WHEN and how to water plants are matters not to be decided offhand, save by the most experienced and thoughtful of plantsmen. It is also difficult to explain when and how to do this except in a very general way. Mr. J. Thomas, gardener to the Bishop of Wakefield, Bishopgarth, however, recently gave some valuable hints on the various points in connection with the question at the Wakefield Paxton Society. Mr. Thomas considered watering to be the most important operation in connection with plant growth. Plants grown in rooms were benefited by an immersion in water at the same temperature as the room for about ten minutes once a week. Water should never be given before needed, neither should plants be allowed to become really dry. Plants out of doors should be thoroughly soaked, not merely surface watered. Rain water was the best for all purposes. The best time for watering plants during summer is the evening, but in winter morning should be chosen for the work.

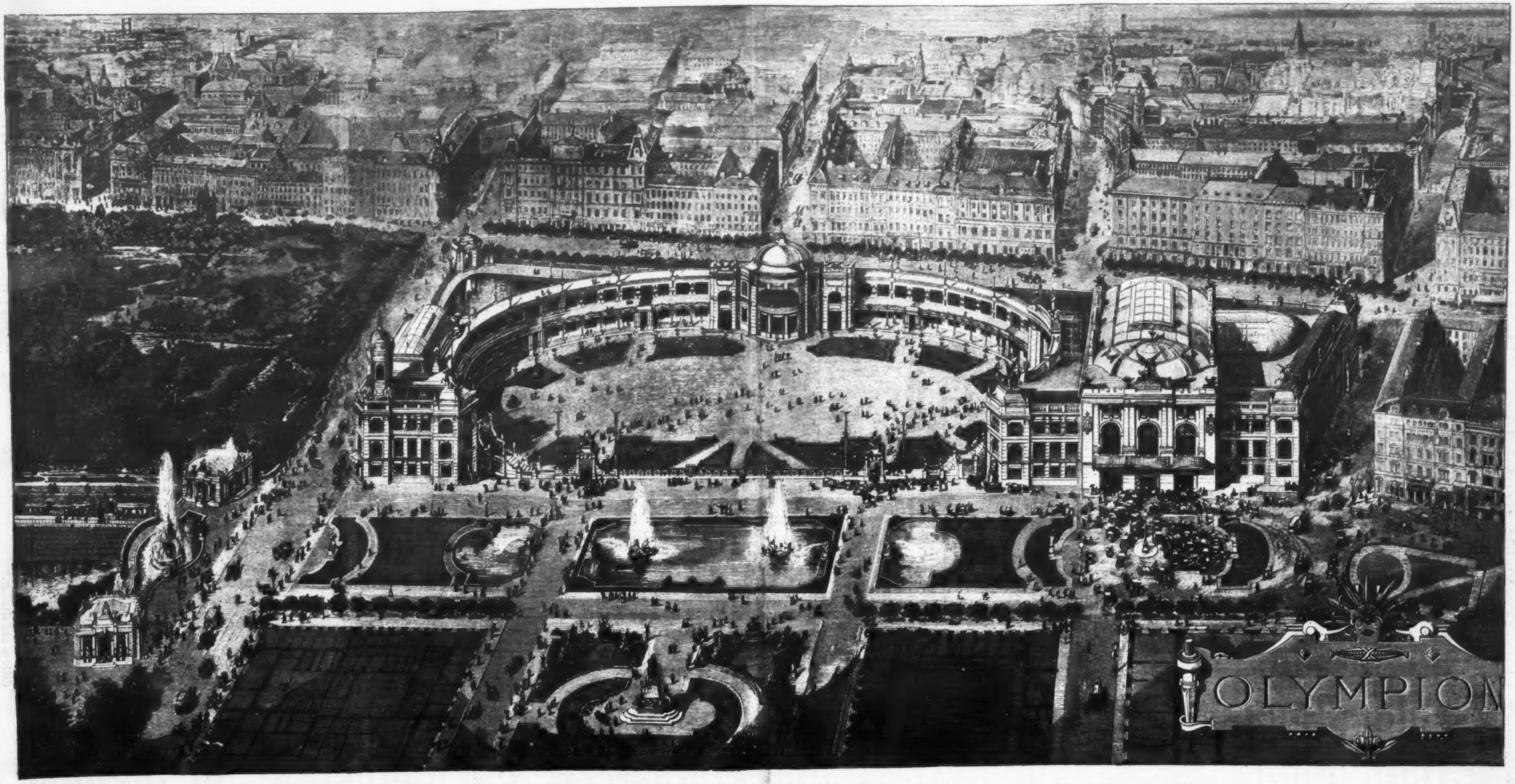
THE voyage of the scientist Mr. Borchgrevink to the Antarctic regions, and his suggestion that a special scientific expedition be dispatched for further Antarctic exploration, the details of which were given in detail in the issue of the SCIENTIFIC AMERICAN SUPPLEMENT of September 21, 1895, are bearing fruit. The British Antarctic committee expects to dispatch a fully equipped exploring party early next September. They will touch at Melbourne, and then proceed to Cape Adair. The ship will land the party at the Cape, and call for them again at the expiration of twelve months, during which time they expect to settle the main question for which the expedition is being formed, viz., the exact location of the south magnetic pole, and to gather a large amount of specimens and data of scientific value. In detail the plan of operations will be as follows:

1. An overland party will travel south toward the magnetic pole.
2. A survey of the coast line will be made.
3. A collection of mineralogical, geological, zoological and botanical specimens will be made.
4. Dredging operations and observations of currents will be executed.
5. General thermometrical, barometrical and meteorological observations will be executed.

A sum of $25,000 is required, and subscriptions are solicited and will be received by the chairman of the executive committee, Royal London Yacht Club, 2 Savile Row, London, W.

ROYAL SOCIETY, January 16.—"The Rotation of an Elastic Spheroid." By S. S. Hough, Isaac Newton student in the University of Cambridge.

Recent researches on latitude variation have brought to light the phenomenon of a periodic motion of the earth's axis of rotation in a period of 427 days. This period being in excess of the theoretical period of 305 days hitherto accepted, Prof. Newcomb has proposed to account for the extension by the failure of the old theory to take into consideration the flexibility of the solid parts of the earth. The author gives an analytical investigation of the motion of a solid body when slightly disturbed from a motion of simple rotation about a principal axis, taking into account elastic distortions due to variations in centrifugal force; the results are found to agree in the main with those obtained by Prof. Newcomb from geometrical considerations. The analysis deals with the case of a homogeneous spheroid of revolution, the ellipticity being such that the body is free from strain when rotating uniformly. Such a spheroid, if of the same size and mean density as the earth and rotating with the same angular velocity, would oscillate in a period of 232 days if perfectly rigid; it is shown that this period would be extended to 335 days in virtue of elastic distortions if the rigidity were equivalent to that of steel. In the case of the earth the period would be still further prolonged in consequence of variations in density, and the period which corresponds to the above degree of rigidity is estimated at about 440 days; whence it is concluded that the observed period may be accounted for by supposing that the earth is capable of elastic deformation, and that its rigidity is slightly in excess of that of steel.—Nature.



THE OLYMPION IN VIENNA AFTER ITS COMPLETION.—FROM A DRAWING BY L. BAUMANN, ARCHITECT.

THE OLYMPION AT VIENNA.

OF all the numerous institutions that will probably be called into existence by the fiftieth anniversary of the accession of the Emperor Francis Joseph, none will exert a wider influence nor be planned on a larger scale than the Olympion, which will be a monumental center, worthy of any metropolis, for the study of musical art and the practice of many sports and pleasures serving at the same time as a home for about eighty clubs and a place where entertainments and festivals of all kinds can be held, the considerable profits of the institution being devoted to charity.

The idea of building the Olympion, says the Illustrirte Zeitung, started with three of the best known associations of Vienna, viz., the Sangerhausverein, which was desirous of having a good music hall; the Eislaufverein, or skaters' association, known all over the world as the highest authority on ice sports, which has been seeking a substitute for its skating grounds that have been taken by the city railroad; and the Bicycle Club, that has for a long time been looking for a centrally located riding track.

The requirements of these three associations could be met by only one place in Vienna, the reservation on the right bank of the stream called the Wien, or Vienna, between the Schwarzenberg and the Tegetthoff Bridges, but there was a law against building on this site, that looked like an insurmountable obstacle. It was, however, set aside by the City Extension Funds Association, which offered to compensate the municipality for the loss of this reserved land by donating another piece of ground, and to the agreement between these two bodies, the Stadterweiterungsfonds and the Gemeinde, the new undertaking owes a most favorably situated piece of land worth hundreds of thousands of dollars.

The cost of the building—over $500,000—will be defrayed by contributions from the capital of the three associations mentioned above and different clubs, and by an issue of bonds, and after all of this has been refunded the profits of the institution will, as has been stated, be used for charitable purposes. The rent of the great hall, the numerous club rooms, the restaurants and cafés, with the net proceeds of the concerts arranged by the singing societies, will amount to at least $60,000. The Olympion will be an ornament to the city and will always serve as a reminder of the anniversary in honor of which it is to be built.

The design of this great structure was drawn by L. Baumann, a pupil of the great master Semper, who took as the basis of his plan the antique arena, the form best suited to the shape of the piece of land at his disposal. The arena is to cover a piece of ground 469 ft. long and 223 ft. wide, around three sides of which the buildings will be erected. The building on the south side will be used by the singing societies, that on the north by the bicyclists, and between these

two will be the rooms devoted to the use of the skaters' asso iation. On three sides of the arena there will be colonnades with tribunes, and the other side will be separated from the Wienflus Boulevard by a railing with two monumental gateways.

The statue of Beethoven, in the Beethoven Platz, is directly opposite the domed tribune and the short axis of the arena. The great master will have to accustom himself to a change of front, for his face should be turned toward the Olympion, that he may be, in a certain sense, the musical patron of the institution. The statue is a masterpiece by Zumbusch. On the Boulevard there will be groups of fountains flanked by two pavilions, one of which will serve as a station for the underground railroad and the other as an annex to the city park.

The Olympion will be provided with halls adapted to accommodate respectively 3,000, 2,000, 1,000, 500 and 300 persons, and the two larger ones will be capable of being thrown together by the sinking of the partition wall, thus forming a hall large enough to hold 5,000 persons, and larger not only than any hall in Vienna, but also larger than the Stadthalle in Mainze and the Trocadero in Paris. In one of the longer sides of the great hall is a niche or recess adapted to hold 400 singers, and opposite it is another fitted with a stage. The large hall is surrounded on all sides by lobbies and restaurants connected by colonnades, and three grand staircases lead down to the dining rooms and to the arena. The other halls will be used for concerts, balls and meetings of all kinds. In the second story there will be rooms for from sixty to seventy clubs and societies. A second large niche or recess for singers and orchestras will open toward the arena. Underground there will be gymnasiums, boxing rooms, bowling alleys, shooting galleries, kitchens, cellars and store rooms.

In the part of the structure set aside for bicyclists there will be, besides numerous club rooms, the hall containing the track for wheel practice. A new and very ingenious arrangement has been worked out for the skating societies. The iron galleries underground and on the ground and first floors contain, besides the conversation rooms, restaurants, ladies' rooms, dressing rooms, etc., not less than 10,000 lockers for skates. The skaters step directly from the terrace upon the ice, for the care of which proper machines will be provided. A covered rink with artificial ice will make it possible to enjoy this most healthful exercise regardless of the seasons and the capricious changes of temperature. On three sides of the arena, which will be used by the skaters during the winter, there will be comfortable seats for 15,000 spectators, who may gather to watch the ice carnivals, or, in warmer weather, to assist at other festivals more appropriate to the season; such as monster concerts given by the singing clubs, mass meetings, temporary exhibitions, charitable bazars, athletic entertainments, etc.

These slight hints will give an idea of the important place that will be occupied by the Olympion, and the influence that it will have on the social and artistic life of the capital. Work on the structure will be begun soon, and its completion will depend on the progress made in arching over the Wien and the city railroad. When the jubilee year arrives it will be well under way. The ancient Greeks had to travel long distances to Olympia for their games and contests, but the inhabitants of Vienna will find their Olympion much more convenient, for it lies in the heart of their city.

COLUMNLESS GAS HOLDERS.

WE present an illustration of a gas holder without guide framing, constructed under the patents of Gadd & Mason, of Manchester, England. In the illustration the guides are outside the holder and well. The construction is quite simple; the guides are made of two channels fastened back to back, so as to make an I; this is riveted onto the holder, either inside or out, as the case may be, spirally, at an angle of 45 deg. As soon as one guide runs out or stops at the top of a section, the next one starts at the bottom directly under the upper end of the first, and so on, as nearly as the circumference can be divided.

This brings the guides that are opposite each other at any diameter of the holder at exactly right angles to each other. The bottom of each lift, if internal guides are used, has at each guide two small guide wheels which clamp onto the guide rail and travel smoothly on its web. The holder rises with a spiral motion and must be perfectly rigid. If external guides are used, as in the holder shown in the cut, the guide rollers come at the top of each section.

The manufacturers of this type of holder put forth the following claims for this form of construction:

1. The total weight of the entire structure of gas holder is reduced from 30 per cent. to 50 per cent.

2. The cost of freight transportation and erection is reduced to the same extent, and in cases where gas holders are shipped long distances, or to places difficult of access, this represents a very large amount of money.

3. The cost of painting columns and girders periodically is saved.

4. The construction of a tank is simplified, the tank wall (of whatever construction) is a regular cylinder. There are no piers needed, and all expensive foundation stones for the bases of columns on standards are dispensed with.

5. The removal of heavy guide carriages and rollers from the top curbs considerably lowers the center of gravity of the structure, and dispenses with the extra strength of sheeting necessary to carry these at the points where they are attached to the gas holder.

6. As there are fewer parts, there is less liability for the gas holder to get out of order in working.

7. The mode of construction lends itself to various means for special strengthening with the minimum addition of weight. The method of construction is simplicity itself.

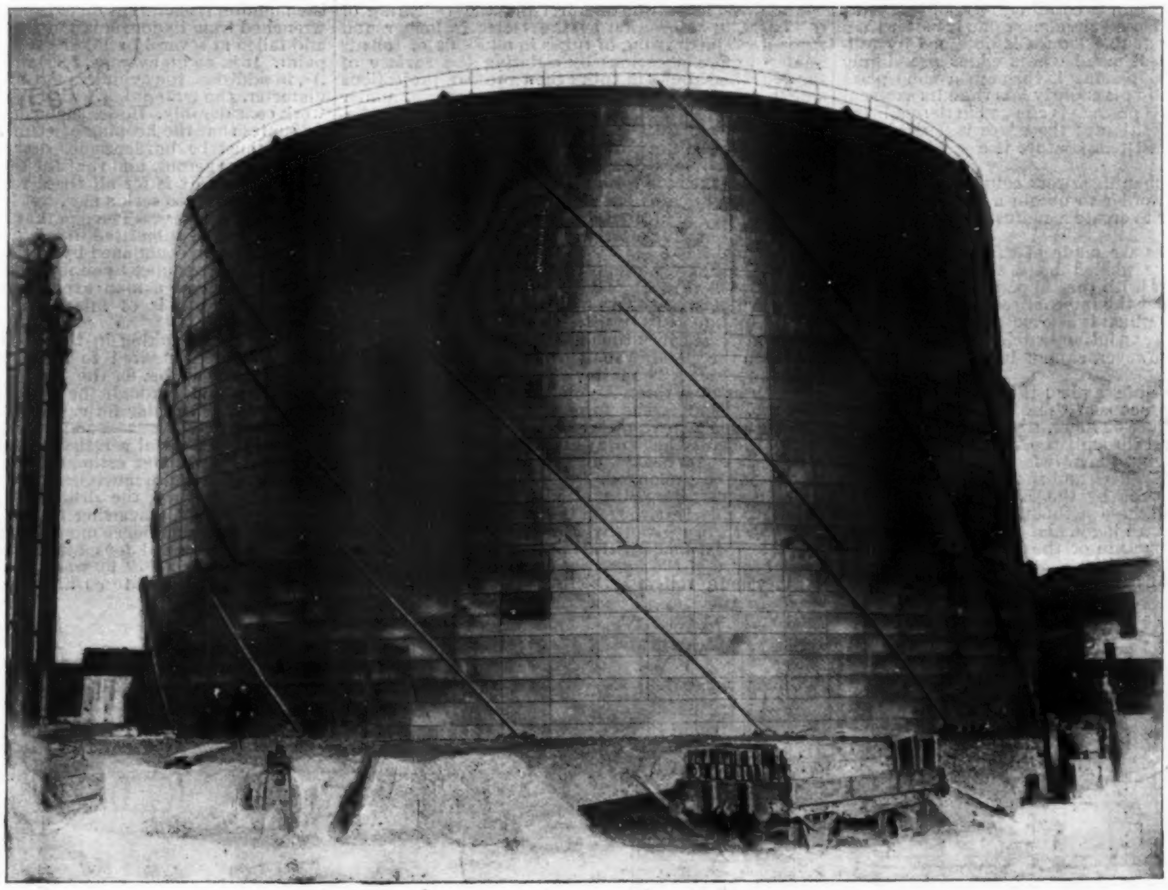
8. The stability of a gas holder constructed upon this system, when under wind pressure, is at least equal to, and from experiments and calculations made, is far in excess of that of a holder of the same dimensions guided by the elaborate guide framing at present in use.

9. Tilting or overturning of the gas holder is, under the patented system, rendered utterly impossible; thus accidents of that particular kind can never occur.

10. The plan adapts itself to telescoping to any reasonable extent, and enables very shallow holders or lifts to be employed with perfect stability.

Another advantage claimed is that there are no limits to the different dimensions that can be built; and if properly designed there will be no trouble from wind, as they will all stand with safety a wind pressure of 50 pounds per square foot. No trouble is experienced from the accumulation of snow on one side of the top, since a heavy side load will in no way cramp the holder and need not be removed unless the pressure is increased too much.

While there are upward of fifty holders of this class now in satisfactory use abroad, the introduction of columnless holders is yet to be witnessed on this continent. We shall, however, soon have one of this last mentioned type, since the new gas enterprise now under way at Halifax, Novia Scotia, has contracted with the agents in America, the Gas Engineering Company, of Pittsburg, for a holder of this description of 300,000 cubic feet capacity. The erection will be started during the coming spring.—Progressive Age.



COLUMNLESS GAS HOLDER.

THE FASTEST OF FAST RUNS.

THE Brooks Locomotive Works, Dunkirk, N.Y., have published a pamphlet giving full particulars of the extraordinary fast run made from Chicago to Buffalo on the Lake Shore and Michigan Southern Railway on October 24. The pamphlet contains a table giving leading particulars of the fast record-breaking runs made by the London and Northwestern and Caledonian Railways; the New York Central and the Lake Shore and Michigan Southern Railway. Fine halftone cuts of engines "599" and "564" of the Lake Shore are given, and a variety of press comments upon the run are quoted. This pamphlet will be a very convenient reference to those interested in high train speeds, as it contains official figures of the three fastest runs on record. Any one interested in fast speed can obtain a copy of the pamphlet on applying to the Brooks Locomotive Works, Dunkirk, N.Y.

The builders have sent us the following facts concerning the fuel and water used by Brooks engine "564," which made the run of 86 miles in 70 minutes and 46 seconds, an average speed of 72·92 miles per hour:

Distance run	86 miles.
Coal used, total	3,250 lb.
Coal used per mile	37·79 lb.
Water evaporated	3,700 gals.
Water evaporated	30,833 33 lb.
Water evaporated, per lb. of coal	9 48 lb.

These figures present facts which make the record more surprising than ever. The engine has 28 square feet of heating surface, and burned coal at the rate of 2,746 pounds an hour, which is close on 100 pounds to the foot of grate area. The prevailing doctrine and belief is that fuel burned under such conditions must result in great waste of heat, yet this engine's boiler evaporated 9 48 pounds of water to the pound of coal, very good performance for a well-designed stationary boiler. It is evident that there are still a good many things about the economical rate of combustion that have not yet been satisfactorily settled by the engineering world.—Locomotive Engineering.

SUEZ CANAL.—From the annual report of the Suez Canal it appears that of 3,352 ships, passing through either way, 2,386 were English; 296 German; 101 Dutch; 185 French; 78 Austrian; 63 Italian; 41 Norwegian; 35 Russian; 33 Turkish; 28 Spanish; 6 Japanese; 5 American; 2 Egyptian; 2 Portuguese; and 2 Nicaraguan.

THE MANUFACTURE OF METALLIC TUBES BY THE BOULET PROCESS.

The iron and steel tube industry is day by day assuming greater and greater proportions, and is delivering to commerce three categories of tubes called "butt-welded," "lap-welded" and "seamless." Each of these presents qualities of cheapness and resistance, and it may be said that up to the present what one of these has gained in one direction it has lost in another. The process that we are going to describe has been specially devised for the cheap manufacture of tubes possessing all the strength compatible with the material used in making them.

In order to facilitate an understanding of the matter, we shall briefly recall the processes employed up to the present for giving iron and steel a tubular form.

The butt-welded tube, the feeble resistance of which

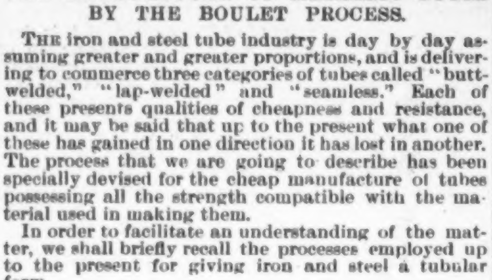


Fig. 1.—WELDING LAP-EDGED TUBES BY ROLLERS.

limits its use to the transmission of liquids and gases under low pressure, and to certain pieces of construction for which the closed circular profile is better than the U or single or double T ones, is obtained by rolling a strip or skelp of metal whose edges are simply juxtaposed, and in passing it through a cone plate whose internal section is slightly less than its external development. This passage is effected in the cold way if a simple juxtaposition of the edges is desired, and at a slightly elevated temperature if a welding is desired.

Certain foreign manufacturers employ skelps with an oblique edge in order to obtain a sort of lapping, and thus endeavor to create a confusion with the following products.

Lap-welded tubes are made of skelps with a very wide bevel and are welded by a stronger pressure, usually with rollers, with the aid of a mandrel (B, Fig. 1) designed to render the internal section of the tube regular, and upon which is exerted the pressure that permits of obtaining an intimate welding. This method of manufacture, however, cannot be applied to large diameters.

The manufacture of seamless tubes can be done in different ways, by means of the direct drawing of an ingot through a plate or roller, the drawing of an ingot upon a mandrel through the repeated blows of a swiftly moving stamp, the drawing of an ingot upon a mandrel by special rollers, and the direct conversion of a solid bar into a tube by the Mannesmann process. Upon the whole, all these methods, except the last, consist in drawing out an ingot, and the main thing is the preliminary manufacture of the latter, which should be long and relatively thin.

Drawing by means of the draw plate, the method most employed, is done with the aid of a mandrel (Fig. 2) designed to limit the annular space that allows passage to the tube when it is desired to give the latter considerable thinness. Such thinness, however, is limited by the necessity of allowing the tube to retain sufficient resistance to permit it to support the traction that it must be submitted to during its passage through the draw plate. Such traction has the inconvenience of diminishing the resistance of the tube to internal pressure. This process is lengthy, but gives a finished product.

Mr. Palmer has proposed to substitute for the ordinary stamping matrix the grooving of an apparatus formed of several rollers whose axes are in the same plane (Fig. 3, Nos. 1 and 2). If these rollers have a circular section, the grooving acts nearly like that of ordinary rollers; but if the section has the form of a spiral, a b c d e, the development of the apparatus during its revolution will become a cone. And if to this grooving there be presented a conical ingot mounted upon a conical mandrel, the ingot will always elongate in the form of a cone. But it is possible also to give a strong pressure, and, consequently, to obtain a rapid drawing. The conical form of the mandrel permits of easily removing it from the tube after the operation. This method is very efficacious, but its practical limit is soon reached, because the rollers draw so much the worse in proportion as their diameters are greater.

In 1888 Mr. Boulet proposed the following improvement of the Palmer method. In order to suppress the inconvenience due to the fact that the friction becomes very great when, in order to render the drawing energetic, we increase the diameter of the rollers and their axes, he substitutes sectors, A (Fig. 4), for the rollers. This permits him to obtain a great length of axes of rotation, B, and to reduce their diameters. In closing with wedges the spaces left free by the sectors, A, we obtain a stamping matrix capable of working like the ordinary ones, and that offers the peculiarity that when the ingot, thrust by the mandrel, reaches the line of the axes, the stamping, if the sectors are rendered loose, continues, and there results a true flatting of the edges of the ingot between the mandrel and the sectors. This method of stamping is rapid, but is limited by the development of the sectors. In order to prolong it, one may substitute sectors of helicoidal section for those represented. In this way, the development is infinite, but it is necessary to reduce the number of the sectors to three or four. The length of the ingot remains always limited, for there is a friction between it and the mandrel upon cooling, and the removal becomes so much the more difficult, despite the conical form of the mandrel and the reheating of the ingot, in proportion as the latter is longer and thinner. The drawing of tubes in all kinds of rolls is rendered more efficacious by striating the surface of the groovings, but the tubes then present projections which are effaced only by several passages, under feeble pressure, through smooth groovings.

In 1852 Mr. Muntz conceived the idea of making tubes by presenting an ingot of circular section to the ordinary groovings of rollers for solid profiled bars. This ingot takes the form of a strongly flattened tube, and nothing remains but to open the latter by means of a mandrel or of hydraulic pressure. But, during this operation, cracks occur, and this is the cause of considerable waste.

In 1854, Mr. Selby proposed the following apparatus: A mandrel, A (Fig. 5), fast or loose, and an ingot, B, are placed between two or more cylinders, C, whose axes are oblique with respect to that of the mandrel, and so arranged that the distance of each of the cylinders from the mandrel shall be less than the thickness of the ingot, B. The latter advances upon the mandrel in becoming thin. An endeavor has been made to give the cylinders the form of cones, paraboloids or hyperboloids of revolution, loose or fast; but the following difficulty has always been met with: the mandrel, A, becomes heated, and its contact with the ingot cannot be prolonged.

From a certain point of view, the Mannesmann process is a derivative from the preceding. Mr. Boulet finds the theory given by Mr. Reuter to explain the operation of it inadequate. According to him, the essential cause of the formation of the aperture by the Mannesmann rollers is the following: If we hammer the surface of a metallic cylinder, even as regularly as possible, there soon form in it small fissures that converge upon the axis. This granted, let us suppose that A A (Figs. 6 and 7) be two conical rollers arranged obliquely with respect to each other and revolving in the same direction and with the same velocity. As soon as the bar, C, comes between them, the above effect is produced. The breakage once determined, if the profiles of the cylinders are such that the distance apart of their points of contact with the bar becomes progressively greater, there is no longer a drawing of the latter. In measure as it revolves, its section, first flattened by the cylinders, becomes rounded, and, as the surface circumscribed by its perimeter increases by the same stroke, the space widens in the center of this mass without sensible internal resistance. If the pressure of the cylinders continues, the walls of the tube laminate it one against the other, and the section takes the form of a figure 8. Finally, when the receding of the cylinders permits this buckle to convert itself into a ring, we obtain a tube with a central aperture so much the wider and with walls so much the thinner in proportion as the laminating of the buckled section has been carried further. In the Mannesmann process, use, moreover, is made of a mandrel capable of turning upon its axis, and which is thrust against the tubular part already formed.

However it be with the explanation that he proposes, Mr. Boulet's objection to the Mannesmann process is that it requires so great a motive power that it has been necessary at times to carry the latter to 2,200 horse power. The rollers revolve to no effect for a certain length of time in order to accumulate their live force in a series of fly wheels whose velocity and weight are such that the work accumulated for the

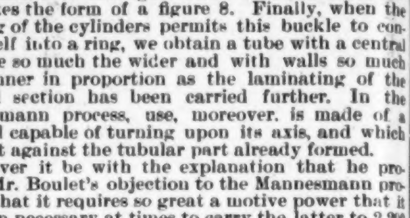


Fig. 2.—DRAWING OF A LAP-WELDED TUBE.

passage of a tube represents, according to Mr. Reuleaux, as much as 14,000 horse power. The velocity of the mandrel is such that an axle out of true has been wrenched from its journals, thrown through the roof, and fallen at several hundred yards from its starting point. It is, on an average, 2,800 revolutions a minute. As, in addition, the cylinders have to be of quite small diameter, the material of which they are formed must work considerably. Under such conditions, Mr. Boulet estimates that the keeping of such an installation in repair must be burdensome, that the running of it must be dangerous, and that the service must require picked men. It is for all these reasons that he has thought it well to seek a new, less laborious and more economical process. The one that he has devised has not as yet been submitted to any trial, and so long as it has not been sanctioned by experience, it will be impossible to pronounce upon its value. Since, however, it is the work of a man experienced in the practice of metallurgy, it is of interest to know something about it.

It consists in making in the body of the solid bar from which it is desired to form the tube incisions, such as a a, o a (Fig. 8), the lips of which are forced outwardly, and, through the extension of these slits, passing to the tubular form. Since in opening these slits one has recourse to a sliding cut, which evokes on the part of the metal a resistance much less than the traction, Mr. Boulet estimates that this method of piercing will require much less work for obtaining the tubular form than the drilling of a solid body by means of a tool traversing it, and that, in addition, the metal will experience much less strain.

The tool proposed for making the slits, o a (Fig. 8), is a sort of punch (Fig. 9), whose cutting edges, a (sections 3-4 and 5-6), are so arranged as to push outwardly the lips of the slits that they form, and so that the deeper the punch enters the mass of the body, the wider the opening becomes, until it reaches the dimensions determined by the sinuous line, uVuV. This tool has three pieces forming a matrix of uniform circular section, save in its upper part, which is widened into a truncated cone, so as to allow the bar, placed in the matrix, to oppose an energetic resistance to sliding when it is attacked by the punch. The latter is firmly set and is thrust against the bar which it penetrates until its setting comes into contact through the metallic lining and forms a tight joint. At this moment, the punch ceases to advance into the bar; but

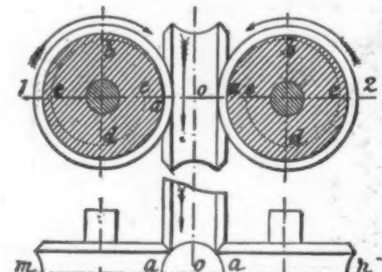


Fig. 3.—ROLLERS FOR SHAPING.

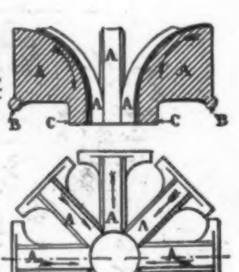


Fig. 4.—ROLLERS WITH SECTORS.

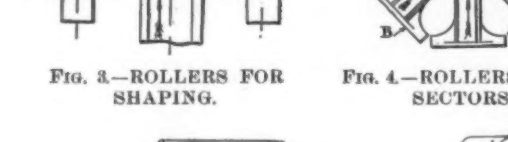
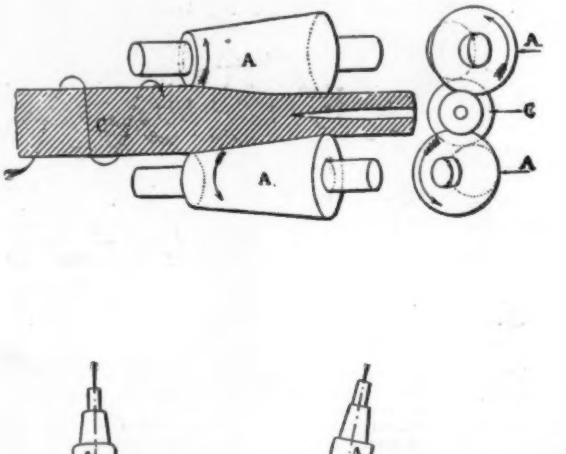


Fig. 5.—SELBY ROLLERS.



Figs. 6 and 7.—MANNESMANN ROLLERS.

if, through a channel, a fluid under sufficient pressure is made to enter, it will resume its travel and the tube will form. In fact, says Mr. Boulet, the junction of the cylindrical part of the punch with the cutting part is effected through the undulating line, uVuV... (Fig. 9), of a diameter greater than the cylindrical part. It results that the fluid, passing around the latter, reaches the line, uVuV... and exerts its pressure upon the walls of the tube in course of formation, which it presses strongly against the matrix. Now, the friction that the sliding of the tube would necessitate if it had to break according to one of its sections, situated with the line, uVuV..., would be stronger than the resistance of the metal of the tube itself, so that such breakage is possible only according to uVuV... But this line may have a development from four to ten times greater than the straight section of the tube, and therefore permits of an action from four to ten times greater than an extension by the draw plate. Moreover, such resistance may be utilized in the traction of the sinuous line almost to breakage; for, although the metal is altered by the excessive traction that takes place at the time of its passage under the sinuous line, it is immediately regenerated by the energetic pressure of the fluid that compresses it—that forges it in a word, against the matrix at a pressure sockets, m, cast in a piece with f and sliding in the sockets carried by the rings, l), arrest it at the point where it is desired that there shall be the proper quantity of water in the cylinder, r k l. Two diametrically opposite bolts are hollow in order to serve as cylinders to plungers, b, which are themselves hollow and fixed to lugs, y, cast in a piece with L. In this way, the water entering through r, passes into these cylinder bolts and repulses the piece, f. If we consider the instant at which the piston, d, is at the bottom of the cylinder, r k l, before the charge of water is introduced into it, the receding of the pieces, f and d, determined by the thrust of the pistons, v, permits of the introduction, between the pieces, e and e₁, of an iron plate or membrane of proper resistance. But the receding of these pieces, f and d, is limited by the pistons, L, fixed at d (Fig. 14). As these pistons slide in cylinders, g, fixed at f, and as the cylinders, g, are in communication, interrupted at will, with the cylinders, J, though the pipe, x (Fig. 14), carrying a distributer, as soon as we put the cylinders, J and g, in communication, the piston, h, being larger than the plungers, v, the piece, f, will approach p and make a solid joint of the channel, s, through the plate or membrane introduced between e and e₁. When this joint is made between f and d, the quantity of water

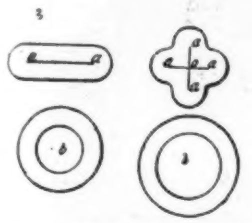


FIG. 8.—INCISIONS MADE IN A SOLID BAR.

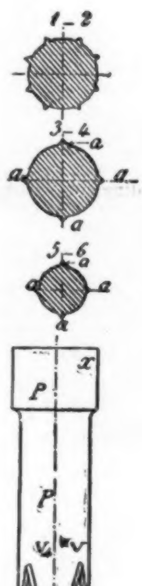
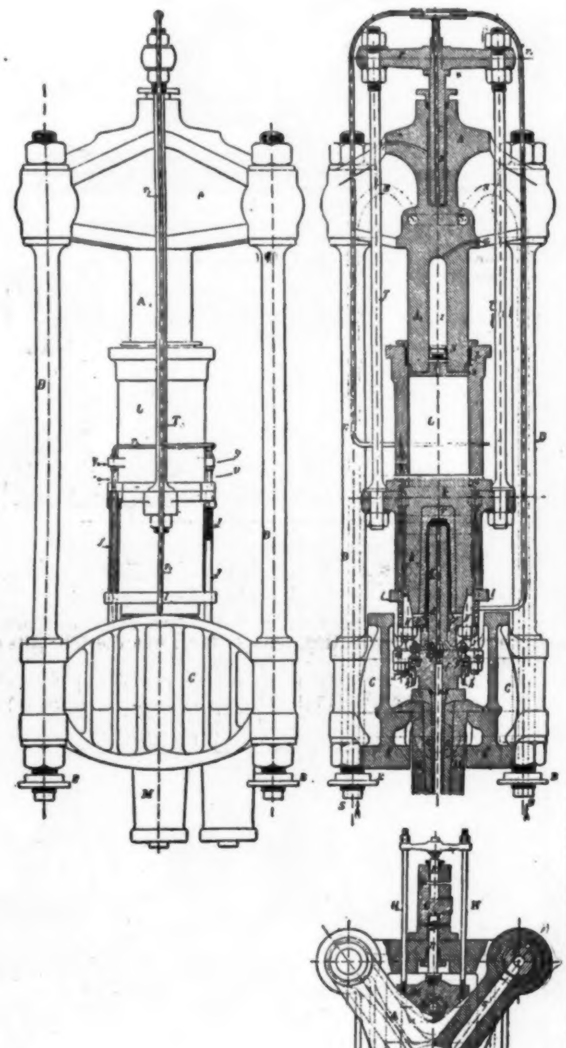


FIG. 9.—BOULET PUNCH.



FIGS. 13 TO 15.—DETAILS OF THE BOULET APPARATUS.

often greater than 3,000 kilogrammes per square centimeter, while drawing through the draw plate is limited to the charge not altering the elasticity of the metal treated.

When the tube is formed, it is taken from the matrix after the pieces have been removed by their lower part. The apparatus in which the preceding manufacture should be effected is represented in Figs. 13 to 15. It operates as follows:

Let us suppose that the motive fluid admitted into the cylinder, L, be water under pressure, that the fluid introduced into the cylinder, r k l, also be water, and that, at Z, there be compressed air. The figures represent the apparatus as we find it at the end of an operation—all the distributions closed and the press at rest. In order to begin another operation, let us follow the communication of the cylinder, L, with the external air. The piston, D, which always communicates with an accumulator, being no longer retained by the pressure of the water stored at L, ascends and carries the cylinders, L and r k l, with it. When all this ensemble is high enough, let us close the discharge distribution and open the communication of the tubes, t, with the bottom of the lining, q. The water traverses the latter, and, as the channel, s, is obstructed, exerts a pressure upon the piston that causes it to descend until the nuts of the bolts, J (fixed to necessary for the operation may be introduced into the cylinders, r k l.

These arrangements being made, let us introduce the punch, P, into the piece, f, and put one of the matrices, M, containing the bar, b, under the press, and let us open the low pressure distributer. The water will rise through the column, B, whence it will pass into the arm of the piece, A, through the conduit, S, then into S₁, and thence into the cylinder, L, through the apertures, t (Fig. 15). The cylinders, L and r k l, will descend through the pressure of the water, whose tension is sufficient to cause the punch to penetrate the bar. When the piece, f, is upon the point of meeting c, an automatic mechanism arrests the introduction of the water under feeble tension and establishes that of the water under high tension.

The water contained in the cylinder, r k l, therefore supports the entire power of the press, and this abrupt tension causes the joint, e and e₁, to cede, so that the water contained in the cylinder, r k l, immediately thrusts the punch into the bar, into which it makes its way in forming the tube. When the latter is to be removed, it is well since the expulsion of the punch under a pressure that often exceeds 3,000 kilogrammes per square centimeter would inevitably injure it) to arrest the introduction of the water into the cylinder, L, and to open the communication with the compressed air contained in the chamber, Z. This air is isolated from the water of the cylinder, L, by the piston, N, movable in the chamber, Z, which drives beneath it the water contained in the cylinder, L. The latter thus continues its descent with a progressively decreasing yet sufficient force to expel the punch. After that, all that remains to be done is to remove the tube from the matrix. It is useless for us to say that a tube already formed by a preliminary operation can be drawn by a second of the same kind.

Such, in its broad lines, is the Boulet process. We terminate this description in recalling that it is well, before pronouncing upon its practical value, to await the result of the trials that are to be made with the installation in course of construction, and in which the late Mr. J. Mignon and Mr. H. Rouart have given the inventor valuable assistance. While hoping that these trials will prove a success and provide French industry with a very useful process, it is impossible not to remark that the new apparatus constitutes quite a complicated whole whose operation may present serious difficulties.—Le Genie Civil.

NOTES ON CEMENT TESTING.

By H. M. NORRIS.

CEMENT, in some form, has been used since the darkest of prehistoric times, and, in an engineering sense, means such a combination of lime, silica, alumina, and iron that when properly calcined, reduced to powder, and gaged with a proper amount of water, it has the property of setting, both in water and when exposed to the action of air.

Natural cement is made from an impure limestone, in which nature has mixed such proportions of lime, silica, and alumina that when the carbonic acid is expelled, the lime is in the proper proportions to make a hard compound with the silica and alumina. This stone is found in various parts of the world, and owing to the comparatively low cost of converting it into cement, has always been a most important factor in the materials of construction. Very little advance, however, was made in cement working until 1824, when a patent was granted to John Aspdin, of Leeds, for the manufacture of Portland cement.

Portland cement is an artificial production made by mixing certain known proportions of clay and chalk, containing silica, alumina, iron, and carbonate of lime, burning this mixture to the point of incipient vitrification, and then reducing the mass to an impalpable powder.

In order to ascertain the quality and characteristics of this powder, it is necessary to be familiar with the maximum results that may be obtained with any given type of cement. This fact makes it of the utmost importance that engineers should have a thorough understanding of the best and most rapid methods of testing cements. No great equipment of scientific education is necessary for this, but to be of any comparative value, all tests should be made under one system. From the engineers' and consumers' view it makes very little difference what that system is, provided all use the same, for what is fair for one is fair for all. A uniform system, besides being reasonably accurate, must be simple, rapid, and easy of application.

Sampling.—Where cement has a good reputation, and is used in large masses, it is usually sufficient if every fifth barrel be tested, but in very important work, such as the thin walls of sewers, it is often necessary to test every barrel; the samples being selected from the interior of the barrel, and at a sufficient depth to insure a fair exponent of its quality. These samples should be placed in some tightly closed receptacle, impervious to light or dampness, until required for manipulation.

Fineness.—The strength of a cement depends largely upon the fineness to which it is ground, for the finer it is the more grains of sand it will cover, and the better it will fill the interstices of the stone. Fineness, alone, however, is no sure indication of its value, as there are some cements so low that no amount of pulverizing will redeem them. In tests for fineness three sieves are used: No. 50 sieve, 2,500 meshes to the square inch, made of No. 35 wire, Stubs' wire gage; No. 74 sieve, 5,476 meshes to the square inch, made of No. 37 wire; and No. 100 sieve, 10,000 meshes to the square inch, made of No. 40 wire. A weighed amount of cement is taken and sieved with the No. 50 sieve. What passes through is carefully weighed, and its percentage of the original amount calculated. A similar amount of cement is taken and tested on the No. 80 sieve, and similarly on the No. 100 sieve, the percentage passing through being calculated. These measurements are made on a small scale weighing to 0·0001 of a pound. For comparative tests, briquettes should be made with cement that has passed through a No. 100 sieve, but for a particular piece of work the cement should be used as it comes in the barrel.

Sand.—When tests are made to determine the value of a cement for any particular piece of work, the sand used should be the same as is to be used in the work, but for comparative tests it is necessary to use a standard sand that can readily be duplicated. For this purpose crushed quartz is used, the degree of fineness being such as to pass a No. 20 sieve, and caught on a No. 30 sieve.

Mixing.—The mixing of the mortar for testing should be done upon glass, porcelain, slate, or other non-absorbent surface. It must be done thoroughly, rapidly, and in a constant temperature between 60° and 70° Fah. For natural cements, use one part cement and one part sand; and for Portland cements, one part cement and three parts sand. These proportions are by weight. Mix thoroughly, and then add sufficient water to give the mass the consistency of damp sand. To obtain good results, as little water should be used as possible, the actual amount depending upon the quality of both the sand and cement, and also the proportions in which they are used. There is little danger of using too little water, only 20 to 25 per cent. being required for neat cement, 15 per cent. for one part of sand, and 10 to 12 per cent. for three parts of sand. These percentages are in proportion to the combined weight of the cement and sand. In preparing a quantity of cement for neat or sand briquettes, this mixture should be thoroughly kneaded by hand, using rubber gloves as a protection, and

afterward troweled until perfectly homogeneous. For neat tests, the cement should be worked until it sheds water, and with sand until all the grains are covered.

Moulding.—When the sand and cement are thoroughly incorporated, the mortar is pressed into oiled moulds with sufficient pressure to exclude all air bubbles and make the briquettes compact and uniform. After filling, the moulds should be smoothed off on both sides with a spatula or trowel, and laid away under a damp cloth for twenty-four hours, when the briquettes should be removed from the moulds and immersed in water of 65° to 70° Fah., care being taken that they are completely submerged.

In making briquettes by hand, it is usual to mix only sufficient mortar to make five tests. With a larger quantity there is danger of an incipient set, and the necessity of reworking the mortar. The evils attending this operation are well understood, and it is for this reason that several machines have been designed by the use of which briquettes are not only made much faster, but insure a much greater uniformity, the variation being reduced to about two per cent.

To make five briquettes of standard size of the neat cements requires about one and two-thirds pounds of material; and for those containing one part of cement to three of sand, about six and two-thirds ounces of cement and one and one-quarter pounds of sand.

Setting Test.—The rapidity with which a cement loses its plasticity shows its initial hydraulic activity. Cements that set in less than half an hour are termed quick setting and those requiring a longer period slow setting. Quick setting cements should not be worked longer than a minute, or slow setting longer than three minutes. As soon as the cement has assumed sufficient hardness to bear the gentle pressure of the finger nail, it is considered as beginning to set. The time of setting is usually measured by the penetration of a steel point, termed "The Needle Test." This test was first used in this country by Gen. Q. A. Gillmore, and consists of a one-twelfth inch wire, loaded with one-fourth pound, and a one-twenty-fourth inch wire loaded with one pound. Pats are made of neat cement about two and one-half inches in diameter, one-half inch thick in the center, and one-fourth inch thick at the edges. For the initial set, the time is recorded from when they are made to the time when they will support the one-fourth pound weight without making an impression, and the final set until they will support the one pound weight. If the pats will not bear the one fourth pound weight after five hours, the cement should be rejected.

Checking Test.—The test for checking or cracking is an important one. Make two pats of neat cement same as for the setting test, and note the time it takes to set hard enough to bear the one-fourth pound and one pound loads. When hard enough, one of these cakes should be placed in water and examined from day to day to see if there are any indications of contortions or cracks. The other pat should be kept in the air and its color observed, which, for a good cement, should be free from blotches.

Boiling Test.—Make a briquette or thin cake of neat cement as above, allow it to set hard in the air with a damp cloth over it for twenty-four hours, then immerse in boiling water and boil for twenty-four hours. This boiling causes the coarse grains to disintegrate; and if there is an excess of free lime in the cement, the caustic lime, becoming hydrated, swells and causes the cake to crack. This cracking and disintegrating is called "blowing," and any cement acting this way should be rejected. Care must be taken, however, not to confuse the fine hair lines found on the surface which cross and recross each other with the coarser, wedge-shape cracks due to swelling or blowing, for the fine lines are merely the result of slight changes in temperature, and do not denote a poor cement. This test should be used in conjunction with the sand test and test for fineness to determine accurately the quality of the cement.

Tension Test.—The test for tensile strength is the most common of all tests, though not a perfect indication of the value of a cement. It is frequently the only test used in comparisons of different kinds, but the results obtained from neat cements do not give uniform conclusions regarding the binding properties of the cement and sand. In comparing several varieties of cement, it is necessary to use a high percentage of sand, as the setting properties of different varieties vary much with the amount of sand. A proportion (by weight) of one part cement to three of sand is taken as the standard for Portland cements, and equal parts of sand and cement for natural cements.

After the briquette has attained the requisite age, it is placed in the testing machine and subjected to a strain of 400 pounds per minute until fractured. In adjusting the clips to the specimen, the greatest care must be exercised that everything comes to a full and even bearing, as carelessness in this respect leads to a greater variation in results than from any other cause. Briquettes for tensile tests are left one day in air and one day in water, or one day in air and six days in water, or one day in air and twenty-seven days in water. These three are the usual tests, though the briquettes are sometimes allowed to remain in water as long as a year.

Compression Test.—The test for compressive strength is a most important one and should never be omitted, for in practice mortar is chiefly called upon to withstand pressure. After a cement is allowed to harden for a few years it ceases to grow in tensile strength, but its resistance to crushing continues to increase until it becomes like a piece of pottery.

Compressive test specimens, in order to give results that agree with each other, should be made by machinery, either by grinding down the regular form of machine-moulded briquettes into one-inch cubes or by moulding them direct in a machine designed for that purpose.

Bending Test.—The methods of testing cements by flexure possess some very marked advantages over the more common practice of testing by longitudinal straining. In tensile tests it is a very difficult matter to adjust the briquette in the clip so that there will be no twist or cross strain, but in the transverse method there can be no such ambiguity as to strain, as the specimen rests free and clear upon two supports, and is broken by the load applied in the center, giving a very great gain in the per cent. of good breaks. Parallelopipedons one inch square by six inches long, placed upon clips with four-inch span, give very satisfactory results.

Abrasive Test.—Cement that is to be used for sidewalks, floors, artificial stone paving blocks and the like, should be subjected to this test. And not only should the neat cement be tested, but also the mixture of cement and sand that is to be used in the actual work.

To prepare a specimen for the abrasive test make an inch cube of the neat cement or cement and sand and allow it to harden under water for not less than seven days. Upon removal, dry thoroughly and remove all loose particles with a stiff brush, then weigh and place in the testing machine.

This machine consists of a revolving hardened steel disk, upon which the specimen is automatically moved slowly back and forth. Above the disk is a weighted lever or graduated beam capable of loading the specimen up to two hundred pounds. The bracket supporting this beam is fitted with a sand box and water cock, each of which is provided with means of regulating the supply, giving more or less sand or water as the nature of the test demands. The apparatus is provided with a revolution counter which automatically registers the revolutions of the disk.

After the specimen is subjected to this rubbing action for a given time or registered number of revolutions, it is removed, again weighed and the loss carefully noted. The loss of weight of an air specimen is greater than that of a water specimen, and the loss of a neat cement greater than that of mortar.

Absorption Test.—This test is used to determine the relative density of briquettes, the common practice being to use an end of a fractured specimen. This, after being thoroughly dried, is placed in an oven of 100 degrees Centigrade for two hours. It is then weighed and immersed in distilled water for twenty-four hours, when it is removed, again weighed and the gain in weight carefully noted, the percentage being computed in terms of the original weight.

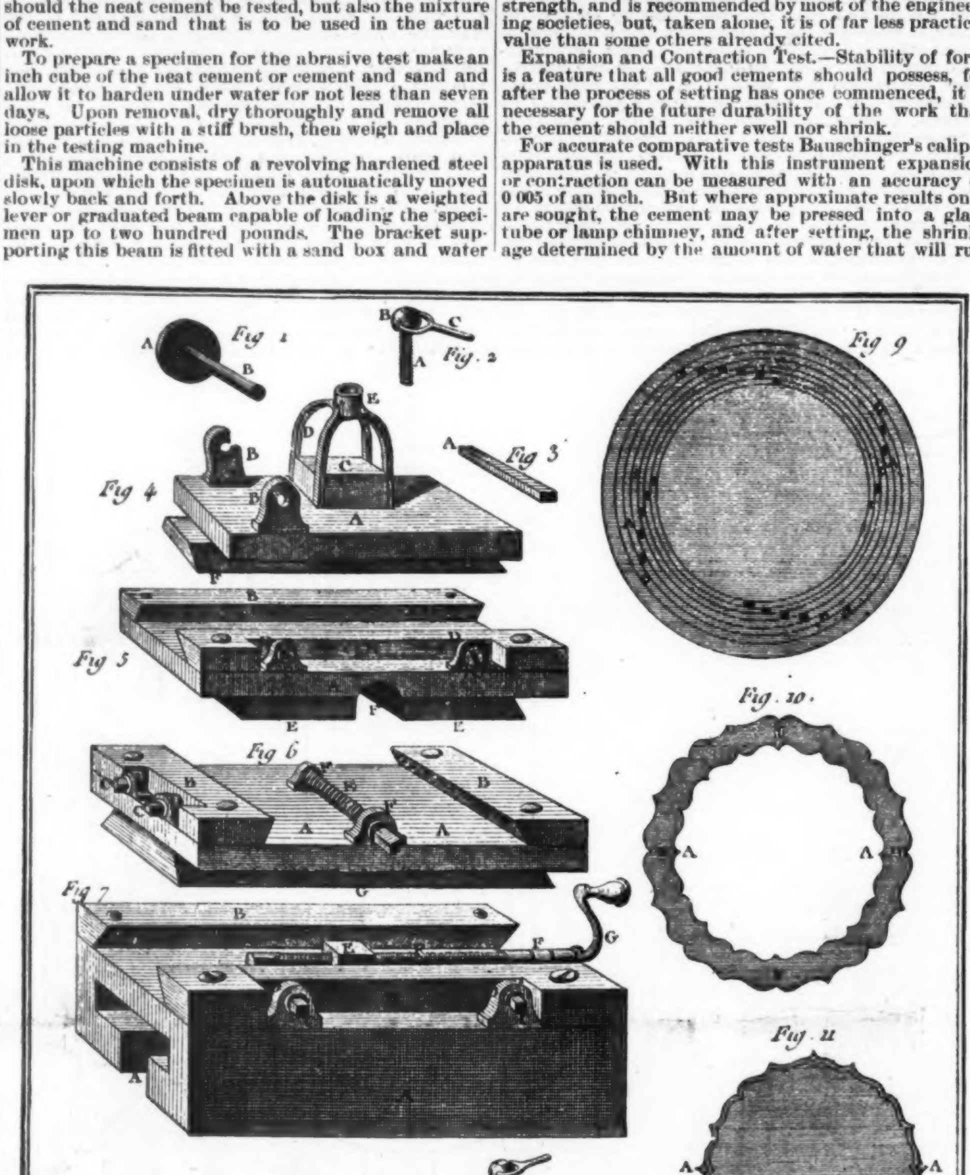
Adhesion Test.—In the test for adhesion the best comparative results can be obtained by connecting together two thick, coarsely ground pieces of glass and allowing them to harden under a damp cloth for twenty-four hours before immersion, then pulling at the end of twenty-eight days. But if the tests are made for a particular piece of work, the same material should be used in the tests that is to be used in the work, care being taken that the brick or stone be wet in exactly the same manner as for the work itself.

Cohesion Test.—This test is the same as for tensile strength, and is recommended by most of the engineering societies, but, taken alone, it is of far less practical value than some others already cited.

Expansion and Contraction Test.—Stability of form is a feature that all good cements should possess, for after the process of setting has once commenced, it is necessary for the future durability of the work that the cement should neither swell nor shrink.

For accurate comparative tests Bauschinger's caliper apparatus is used. With this instrument expansion or contraction can be measured with an accuracy of 0 005 of an inch. But where approximate results only are sought, the cement may be pressed into a glass tube or lamp chimney, and after setting, the shrinkage determined by the amount of water that will run down the inside; any undue amount of expansion showing by the breaking of the glass.

Sugar Test.—It has been stated that the use of sugar in lime, as practiced in India, was beneficial, and that one-half to one per cent. by weight of sugar would, in from four to six months, show a considerable gain in strength. Recent experiments, however, tend to disprove this theory, and go to show that sugar has the opposite effect and weakens cements.—Digest of Physical Tests and Laboratory Practice.



AN EIGHTEENTH CENTURY COPYING LATHE.

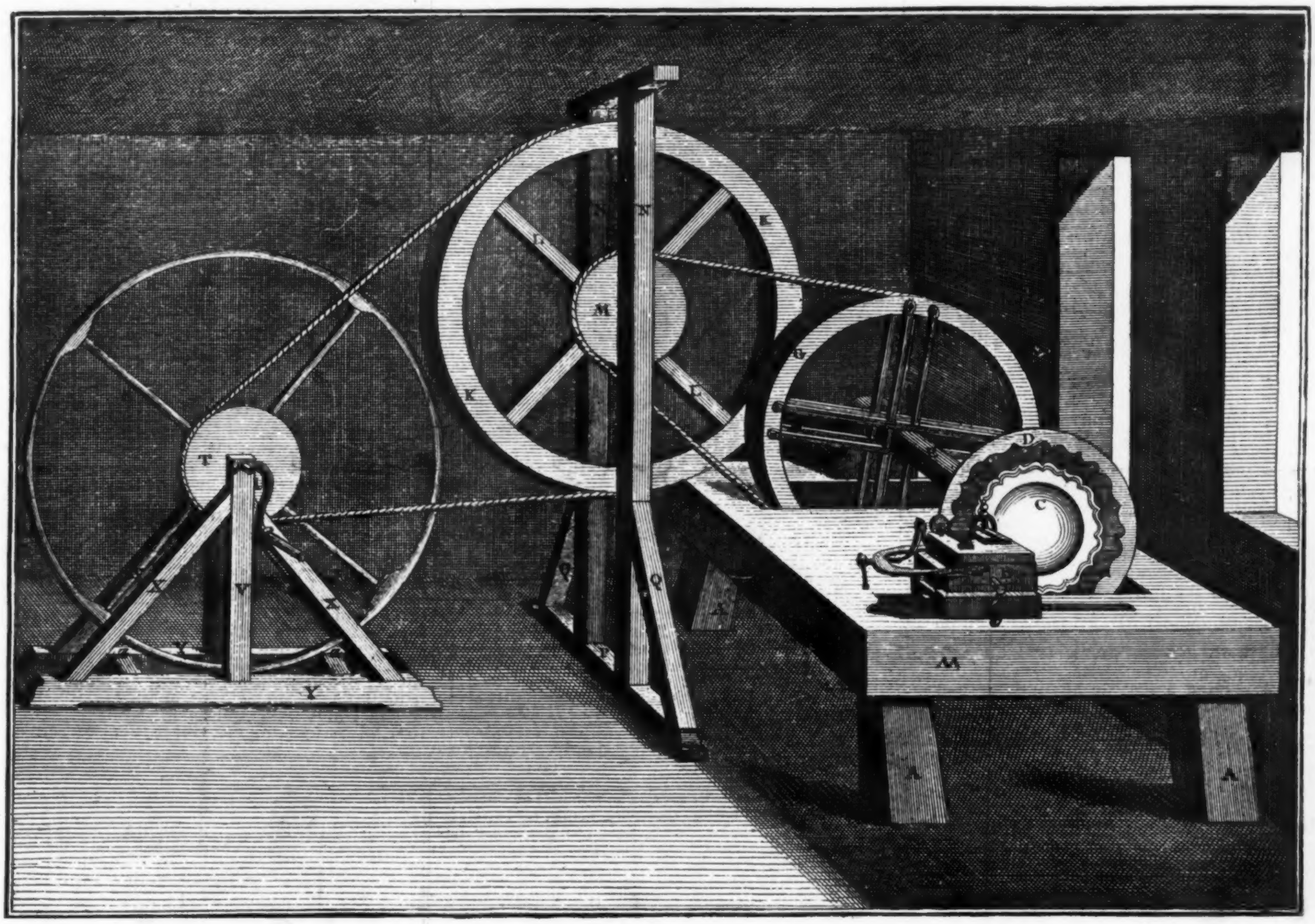
AN EARLY COPYING LATHE WITH SLIDE REST.

WE reproduce from the Encyclopedie des Arts et Metiers, published at Paris in 1771 and recently republished in London Engineer, two plates representing a curious and early form of the copying lathe adapted for forming the scalloped edge and ornamentation of silver dishes. The text gives no account of the origin of the machine, nor does it mention the name of the inventor, the only particulars furnished consisting of a detailed and minute account of the various parts. The mode of action is, hovever, perfectly clear. The pattern is fixed upon the face plate, D,

to which the dish, C, is also attached. The tool is fixed in a veritable slide rest, identical in its principal details with the slide rest of the present day, and this constitutes another interesting feature of this machine.

It is the earliest instance of the appliance which we have met with. As the pattern revolves it causes the rest and tool to move backward and forward, the tool being kept to its work by the spring, shown on a larger scale in Fig. 8. One would like very much to know whether this was merely a design or whether the drawing was made from an actual machine.

It will be noticed that the machine as represented is incapable of producing the particular form of scalloped edge depicted, because the friction roller which bears against the pattern could not enter the deep angles of the pattern. The edge actually produced would be of a wavy character, consisting of a series of easy curves. This is, however, in all probability an error of the draughtsman, who thought that an edge with sharp angles would look better The plates are reproduced not from the original edition of the Encyclopédie, but from a subsequent edition in quarto, published in 1781, under the title of Encyclopédie Methodique. In almost every detail the plates are identical, though on a somewhat reduced scale. The engravings in the folio edition of 1771 show a wavy edge of easy curves such as a friction roller could readily follow. This explanation seems to be necessary to account for an obvious imperfection in the machine as shown. The plates do not, as might be supposed, belong to the article "Tour" (lathe), but form a portion of the illustrations of "Orfévre Grossier" (gold and silver smith). We have no intention of entering into the vexed question of the invention of the slide rest, but here we undoubtedly have a particular form of slide rest, though not applied to the uses to which it was put by Bramah and Maudslay at a later period.



A PRIMITIVE COPYING LATHE.

POWER CONSUMPTION ON ELECTRIC RAILWAYS.

By A. K. BAYLOR.

THE subject of power consumption on electric railways seems to naturally divide itself into two parts; first, the apparatus itself, its efficiency and general construction; second, the handling of apparatus. Properly, a consideration of this subject should start with the coal pile, but it is proposed here to consider it merely in its relation to the electrical apparatus, taking the power as it comes from the engine shaft One of the first questions bearing on the efficiency of the generating plant that must be considered is whether direct connected or belt driven generators are to be used. In a paper recently read before the Pennsylvania Street Railway Association, the writer pointed out that the experience of the last two or three years has shown direct connection to have, in most cases, everything in its favor, and that where land values are high and the units large, these two points alone will dictate the choice of the type of machine. It was at first supposed that great fluctuation of load inevitable in railway work would introduce a serious menace to the unit—i. e., the engine and generator—when the two were rigidly connected; but this has been shown by repeated experience to be a negligible factor when a properly proportioned flywheel is introduced between engine and armature.

In comparing the two types of machines, the first consideration is apt to be the relative cost. As a direct coupled generator is usually designed to give a certain output while running at slower speed than a belted generator for equivalent output, it must be large and cost more than the belted machine. From the difference in cost, however, must be deducted the expense of belts, and several other money saving features must be considered. The direct connected machine takes less room, saving land and permitting the use of a smaller building. Only one foundation is necessary, instead of two, and although the one foundation must be larger than either of the two necessary for a belted unit of equal power, it will usually cost less than the sum of the two. Furthermore, there are fewer bearings and wearing parts to care for, and last, but not least, a saving in efficiency of from 5 to 6 per cent., according to the proportion of load on the generator.

This difference in percentage is due to the fact that the least possible friction loss due to belting is in the vicinity of 4 or 5 per cent., and even if this minimum be preserved at full load, it becomes about 8 or 10 per cent. when the generator is running at half load. These considerations will usually effect a decision in favor of direct coupling, unless they are offset by a saving in interest charges due to an unusually low priced belted generator.

The next point to be considered seems to be the proper division of the plant into units. Generally speaking, perhaps the best investment is made by the installation of three units of equal size, two of which are capable of carrying the full load. This permits efficient running at half load and full load, and leaves one unit always in reserve. It is, of course, desirable for the sake of efficiency and consequent economy of power to run all the working machines as near full load as possible, and to keep "on top" of the efficiency curve, and, with this object in view, some roads have made a division of power into, say, two large units, each equal to one-half the full load, and one small one equal to one-quarter load. This permits full load running practically all the time, as combinations of these machines will give one-quarter load, one-half, three-quarters and full load; but in case one of the large units gives out, the remaining one-half and one-quarter unit will have to be considerably overloaded to handle the full load of the station.

It is interesting to note how daily records of current output by readings taken every few minutes will show the separation of the day into distinct load periods which will repeat themselves with astonishing accuracy from day to day when the same general conditions obtain. For this reason, and because it is impossible to keep playing the generator units into combinations to fit all these fluctuations, it is necessary to choose a generator at the outset with a good efficiency curve; in other words, a "flat" curve, one which rises to 90 per cent. or thereabout, at a comparatively small load, and gradually rises with the load to a high maximum, running then on a practically horizontal line, until the load becomes excessive. As contributing to this result, the machines should run without excessive heating, which means ample capacity in conductors, commutators, and armature, large radiating surfaces, good ventilation, and sufficient bearings. They must run free from sparking up to reasonable overloads, and must have insulation of sufficient resistance to prevent leakages to ground, and after all this they must be kept clean.

Buyers should also remember that the manufacturing companies whose engineers have made these points a matter of special study, and have the experience of scores of plants to guide them, ought to be, and are, in a position to judge intelligently of the general proportions best calculated to give a certain result. The buyers should therefore confine their specifications, in a reasonable degree, to a list of conditions to be fulfilled, naming the heating, sparking, and overload limits required, with other general features, leaving the means for reaching these ends—i. e., the size of conductors, number of commutator bars, thickness of insulation, and the thousand and one details of design which go to make up an efficient machine—to the makers. A great deal would be gained in this direction if consulting engineers fully realized that, unless they have given the matter enough study to qualify them as generator designers, they may, through insisting on some peculiarity of detail and receiving a generator fulfilling their specifications, get a machine inferior to what would have been furnished had the manufacturer been held accountable for results only.

As bearing on the general efficiency of the system, the line should be of ample capacity and of insulation sufficient to withstand the potential at all times. The ground return capacity should, of course, be equal to the overhead feeder. An abundance of overhead copper with bad rail bonding, with, perhaps, open circuits, is an absurdity. As affecting the life of the motors, the feeders should be distributed to deliver as nearly as possible an even potential all over the line, and while the voltage should not be allowed to drop too low, it also should not be raised to any considerable degree above the normal point, as this puts the motor insulation under undue stress. On this account, when cars run directly past the power house, the feeders should not attach directly to the line, but should spread in either direction and feed back to this point. It is evident that when a motor has become dusty or moistened in service, its insulation resistance is reduced, and any excess in potential above its safe limit will result in punctures of the winding and other leakages to ground, whereas, if the pressure be kept inside this limit if only by a few volts, the bulk of such trouble may be avoided.

Of course, the motor is another factor of prime importance in the economy of power, and what has been said under generators regarding efficiency will apply in a general way here. A motor should be as light as is consistent with strength and power, and should be compact and protected by its frame. The most important consideration in the purchase of motors may be safely said to be cost of maintenance, but this has has no direct bearing on the economy of power, much as it has to do with economy of operation.

As a power saver, the most important part of the car equipment is the controller. The time has gone by when it was necessary to draw comparisons between rheostatic and series parallel control in considering equipments; yet a good many lines are operating rheostatic controllers without apparently appreciating the loss they are sustaining.

Aside from the out-and-out saving in power by the use of series parallel control, which amounts to a clean 25 to 40 per cent., according to the series, it should be remembered that the necessary generating

plant for operating with such controllers is much less than that required for the same car service under rheostatic control, not only because of the average economy of power, but because the momentary fluctuations of load, which must be taken care of, are much less violent and this latter condition holds good in any case, even for a high speed road making few stops, and where the motors are kept in multiple so much of the time that the average power consumed is practically the same for both methods of control.

Another practical advantage is found in the possibility of running all the cars at half speed in case of the disabling of half the power house capacity. This is an important consideration, for instance, on a stormy day, perhaps during a snowstorm, when the first desire of patrons is to get aboard cars in large numbers, away from the weather and to be carried to their destination. At such a time the number of minutes consumed in getting there is usually a secondary consideration. Tracing up the subject of operation at the power house, one of the most effective economies is the use of recording wattmeters registering the load continuously. By this means, and in connection with readings on individual cars, load curves may be established, representing fairly (by the division of the day into load periods, as mentioned above, and the current output during these periods) the power which should be consumed to handle a given traffic.

In this way a careful and intelligent comparison may be drawn between different days in a season and between days of similar character. Wattmeter readings on separate cars are of especial importance, establishing as they do for the unit what the station readings show for the whole system. Repetitions under all conditions will show whether a certain car should consume 800 or 900 or some other number of watt hours in running a mile, and any sudden or wide variation to-morrow from the standard load readings of to-day and yesterday will indicate a leakage of some sort and attract prompt attention. Without such a system of checks in the delivery of current, there is nothing but the sluggish coal pile to betray any irregularity in power consumption. In addition to these guards, a recording voltmeter should be used at the station, or a voltage record kept at very frequent intervals. With due allowance for overcompounding, the theoretical record would be a circle, and in practice, with a fairly constant load, the record should approach this standard. If the voltage undergo wide fluctuations, comparing different times of the day, the generator is faulty, or the station man is negligent, and in either case the motors suffer, and they not only require a greater average current to do a given work at reduced voltage, but they will consume more watts in doing it.

A very great factor in saving power is the degree of intelligence of the motormen. They are too often put upon cars with scarcely any preparation, and are then practically left to their own devices, and naturally handle their cars uneconomically. They will often move the controller handle around the dial without regard to the notches, passing into No. 2 before acceleration of the first position has been felt, and so on to Nos. 3 and 4. It sometimes practically amounts to throwing the handle immediately into the first position. As far as economy of power is concerned, such men might almost as well have rheostatic controllers. The pity of it is, too, that, as a rule, the men are not to blame, never having received proper instructions. A valuable aid in the education of motormen is the use of an ammeter in the motor circuit in plain sight, so that during their run the men can see the fluctuations of the instrument and note the results of incorrect handling as compared with the right method. The plan followed by Mr. Know, of the Chicago City Railway, is certainly an excellent one. He has printed curves, laid upon one plot, comparing the current fluctuations with right and wrong methods of starting posted around the car barns and employes' rooms as a graphic object lesson which has resulted in an economy of power. Further than this, motormen should be instructed in the car circuits, with diagrams showing the connections at each position of the controller. With this knowledge a conscientious man would involuntarily make an effort in the right direction.

Another great coal consumer is the brake. A great amount of power is wasted by men who throw their controllers into contact before thoroughly releasing brakes, even when there is no danger of backing. They also throw on the brake before throwing off the power. Very few men understand or attempt to use the momentum of their car to advantage. They will run with power on close up to a leading car and then apply brakes, when they might coast many feet, using no current whatever. This momentum may also be used to advantage on curves, switches, or wherever there is unusual resistance. The careful scheduling of cars with respect to grades may be an important economy, and although it is a complicated problem, it is worthy of more attention than it is usually given. Care should be taken to keep bearings and running gear in good condition and to maintain track gages. The wheels upon any truck should be made of the same diameter (a precaution frequently overlooked) to permit the motors to wear in perfect unison.

A full consideration of this heading leads into every branch of the operation of electric railways, and although the efficiencies of apparatus and the direct handling of it are the first things to consider, every fault in system or operation is directly or indirectly an attack on the coal pile.—Cassier's Magazine.

[Continued from SUPPLEMENT, No. 1051, page 16806.]

THE ARC LIGHT.*

By Professor SILVANUS P. THOMPSON, D.Sc., F.R.S.

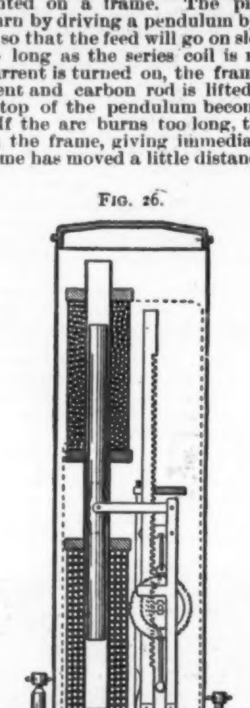
LECTURE III.—Continued.

DEVELOPMENT OF SIEMENS LAMPS.

WE have here, among other pictures, a whole series of German lamps developed by the house of Siemens, illustrating the progress of invention so far as that firm† are concerned.

In one of these (Fig. 26) the differential principle is introduced. The upper carbon is supported by a rod, on which teeth are cut, which engage with a small pinion mounted on a frame. The pinion is only allowed to turn by driving a pendulum by means of an escapement, so that the feed will go on slowly but continuously so long as the series coil is not in action. When the current is turned on, the frame containing the escapement and carbon rod is lifted, striking the arc, and the top of the pendulum becomes fixed in a little nick. If the arc burns too long, the shunt coil brings down the frame, giving immediate relief, and when the frame has moved a little distance the pendu-

FIG. 26.

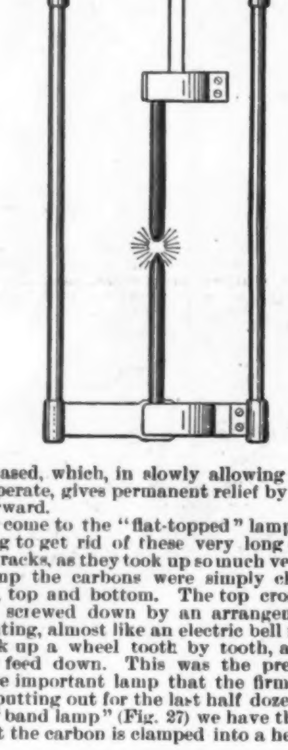


lum is released, which, in slowly allowing the escapement to operate, gives permanent relief by feeding the carbon forward.

Now we come to the "flat-topped" lamp. It was a great thing to get rid of these very long carbon rods with their racks, as they took up so much vertical space. In this lamp the carbons were simply clamped to a crosspiece, top and bottom. The top crosspiece was gradually screwed down by an arrangement with a gear vibrating, almost like an electric bell mechanism, which took up a wheel tooth by tooth, and so drove the screw feed down. This was the precursor of a much more important lamp that the firm of Siemens has been putting out for the last half dozen years.

In the "band lamp" (Fig. 27) we have the same features, that the carbon is clamped into a heavy holder;

FIG. 27.



there is no long carbon rod; the carbon is suspended on a flexible band, or cord of woven copper, that goes over a drum, inside which there is a spring. The weight must be so heavy that it will uncoil that spring, and when you lift it up to put in a new carbon the spring coils itself up again. This mechanism has two toothed wheels to multiply motion, and then an escapement (with a little piece sticking out at the end of it), and the whole is carried on a frame, which can be tilted. This, again, brings us back to the tilting wheelwork which Mr. Brockie had in 1882. In the present case the only magnet is a shunt-wound electromagnet working against a spring. Supposing there is no current supplied to the lamp, that magnet does not pull; the spring pulls back the frame, and the clockwork is locked. When the lamp is put on a circuit, there is no way through it except through the shunt; the magnet will, therefore, pull the armature forward, which motion will lower the upper carbon a little toward the lower carbon, and make them touch; or, if they do not touch, it releases the escapement, and that will work, letting the upper carbon descend until they touch. The moment the main circuit is thus completed, there will be less current going round the shunt; the spring will, therefore, rise, and the clockwork will be locked until such time as it is necessary for feeding to occur.

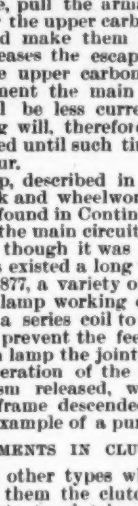
A Belgian lamp, described in 1889, illustrates this feature of the rack and wheelwork turning on a pivot, which is so often found in Continental lamps.

Getting rid of the main circuit coil, and putting in only a shunt coil, though it was not well known, is a feature which has existed a long time. There was the Lontin lamp, of 1877, a variety of the Serrin. This is the first case of a lamp working only by a shunt coil. The Serrin had a series coil to pull down a jointed parallelogram to prevent the feed occurring. In the case of the Lontin lamp the jointed parallelogram was raised by the operation of the shunt coil, and the feeding mechanism released, which otherwise was locked when the frame descended by its own weight. That is the first example of a pure shunt lamp.

IMPROVEMENTS IN CLUTCH LAMPS.

There are a few other types which have developed since 1889, among them the clutch lamps. The next few diagrams relate to clutches that have been developed since that time. The first (Fig. 28) is that of

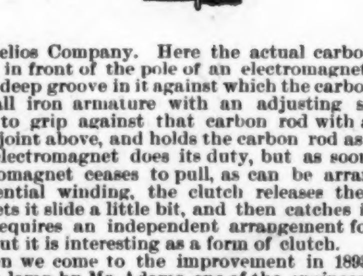
FIG. 28.



the Helios Company. Here the actual carbon comes down in front of the pole of an electromagnet, which has a deep groove in it against which the carbon slides. A small iron armature with an adjusting screw is made to grip against that carbon rod with a sort of knee joint above, and holds the carbon rod as long as that electromagnet does its duty, but as soon as the electromagnet ceases to pull, as can be arranged by differential winding, the clutch releases the carbon rod, lets it slide a little bit, and then catches it again. This requires an independent arrangement for striking, but it is interesting as a form of clutch.

Then we come to the improvement in 1893 of the Brush lamp by Mr. Adams, one of the engineers of the Brush Company in Cleveland. In the old Brush the clutch was a simple ring or washer, which gripped the carbon rod, and raised it. That was replaced by Mr. Adams by a nipping clutch (Fig. 29), with a separ-

FIG. 29.



ate toggle joint arrangement, which in one position pulls the clutch piece away from the carbon rod, and allows it to slip, and in the other position nips it against the rod and holds it up. The question whether the brake piece is to be allowed to advance toward the rod and hold it or to retreat from it depends upon the position of the arm which comes down from the solenoid above, and depends on the larger portion of the clutch being allowed to come down into contact with the floor of the mechanism of the lamp. I have here for exhibition two lamps of the Brush Company's manufacture. One is an example of the Brush-Adams lamp, the other a Brush alternating current lamp, with laminated iron cores for the solenoids, and having the old kind of clutch.

HELIOS ARC LAMP.

Another lamp here, which has titling clockwork, is kindly sent me by the Helios Company. We have here the feature of the two coils, series and shunt, and a kind of seesaw. The operation of that seesaw is, however, to tilt a train of wheels, and the question whether those wheels shall be allowed to turn round or not depends on the amount the clockwork is tilted over, so that that combines the Continental feature now so common of the seesaw. This also is an alternate current lamp; but it has the novel feature of an enameled iron reflector set just above the end of the upper carbon, and surrounding it, so as to throw downward (as shown in Fig. 12, ante) the light that otherwise would be projected obliquely upward. A quite small mirror, fastened on a bridge between the rods

* Lectures delivered before the Society of Arts, London, 1895.—From the Journal of the Society.

† See Alexander Siemens in Journal Soc. Telegr. Engineers, 1880, p. 97.

that form the frame of the lamp, suffices for this purpose.

THE PLANET COMPANY'S ARC LAMPS.

Another type of lamp has been developed by the Planet Electrical Engineering Company, of London. A motor is made to turn one way or the other, according as the voltage of the lamp exceeds or falls short of the prescribed amount, and the motor drives a feeding screw. I have been using a Planet lamp inside this box to illustrate the Trotter phenomenon. It is one of the neat little lamps which the Planet Company is now making specially for projector work, with a motor very neatly packed away at the bottom.

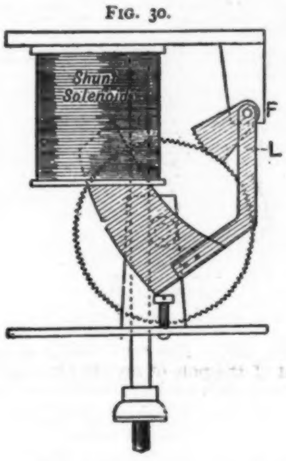
SOME RECENT LAMPS.

Of other feeding lamps with tilting mechanism there are several in existence. I examined a very nice one indeed some few months ago, the invention of M. Caneval, of Rouen, a shunt lamp with an escapement designed to work independently of the tilting of the mechanism.

There are here two lamps of very simple construction, the invention of Mr. Akester, of London. Both are clutch lamps, and the clutch in this case works on the holder of the lower carbon rod, instead of the upper, and the clutch itself is peculiar. It consists of a little box with some small shot in it. When the small shot is compressed between the top and bottom it grips the rod, and will not let it go. When the pressure is released the shot will roll round, and the rod will go through entirely. There is no end to these mechanical devices for clamping and unclamping automatically by the operation of that which governs the lamp, viz., the electric magnetic mechanism.

Two or three other forms containing improvements in details remain to be mentioned. First, there is here a deservedly popular French lamp, the Briane. This is like the English lamps, but having only one wheel. That wheel has a kind of tooth or milling on the edge, and is governed by a small toothed sector. That sector (Fig. 30) is fixed to a long crooked lever, having on

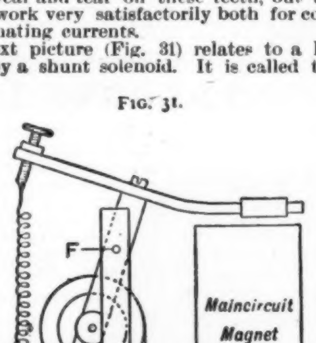
FIG. 30.



its end a piece of iron, which can be sucked up into a shunt coil. The play of the lever is limited by a set screw at the bottom. If the current round the shunt solenoid is strong enough, it will suck up this piece of iron and turn the wheel round a little. If the current is weak, it will descend, and the wheel will turn the other way. Whenever the current through the shunt solenoid becomes very strong, the rise of this piece will carry the toothed sector out of contact, and the wheel will be free to turn. But on the descent of the carbon the current in the shunt coil will at once become weaker; whereupon the lever arm comes down again and the wheel is once more caught. Naturally there will be wear and tear on these teeth, but the lamp seems to work very satisfactorily both for continuous and alternating currents.

The next picture (Fig. 31) relates to a lamp not worked by a shunt solenoid. It is called the Hard

FIG. 31.

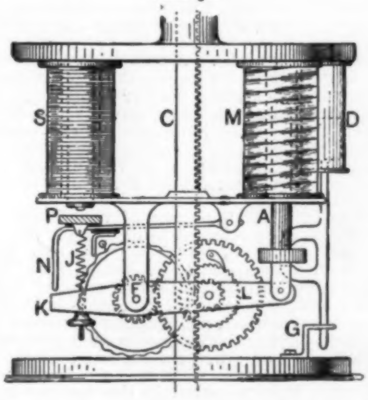


lamp. We find here, again, a single wheel on a tilting frame, the position of which is in this case governed by a main circuit magnet pulling at an armature, and opposed by a spring. The wheel is allowed to turn or is held against a small projecting piece at T. If the current in the main circuit is too strong, it is held fixed. If the arc burns away and the current gets weaker, the armature rises, the wheel is released, and feeding can occur.

THE "THOMSON 1893" LAMP.

In Fig. 32 is shown an American lamp. It is known as the "Thomson 1893" lamp, being the invention of Professor Elihu Thomson, who has designed many successive forms since 1874. In this case a form has been arrived at which has some interesting features. M is a double solenoid, which carries the main current. The yoke, A, operates the lever, L, being, however, controlled by the dashpot, D. The lever, L, forms one side of a frame, pivoted at F, containing the wheel work seen in the figure. The carbon rod, C, gears with the first member of a train of wheels. The last member of the train will be seen to be a wheel with a wavy outline (the waves are much smaller and much more numerous than shown in the figure). The wavy rim is made of silver, and against it there falls, when the lamp is working, an insulated detent, also made of silver. This detent is mounted on a lever to which is also attached an iron strip, P, which forms the armature of

FIG. 32.



the shunt coil, S. The shunt coil is somewhat sluggish in action, as it has its cores surrounded by a copper tube. The fine wire wound over this has a resistance of more than 400 ohms. The connection of the shunt is made through the silver rim and detent, so that when the detent is not in contact, the shunt circuit is broken. The action of the lamp is as follows: When no current is passing, the lever, L, is down, and K being up, supports N, so that the wheel work is free, and the carbons in contact. The current being turned on, lifts L and with it the carbon rod, C, striking the arc, and, at the same time, allowing the detent to fall, thus closing the shunt circuit. When the arc burns long, and S is strong enough, it raises the detent and the lamp feeds one tooth or wave of the silver rim, the current of S being momentarily broken. The sluggishness of S makes the action deliberate and allows the feeding to occur at variations of half a volt. Silver is an excellent metal for a contact such as occurs in this lamp, being better than platinum for the purpose. There is no pumping with this mechanism.

A number of improvements in carbon holders, dust catchers, globe shifters, etc., accompany the lamp. For series work a cut-out is provided, which is merely a high resistance magnet as shunt to the detent contact, and made still more sluggish than S, so that ordinary feeding actions do not bring it into operation, but the opening of the contact without feeding will give it time to act and close a shunt to the lamp. These lamps are also made to focus, and a modified type is employed with alternating currents.

The feature of the shunt acting as an electric bell vibrating arrangement was used some years ago in a lamp introduced by Gramme, which is but little known. The striking of the arc was accomplished by an electromagnet at the top of the lamp, and the feed occurred by the release of the last member of a train of clockwork by a lever which made a vibrating contact in the shunt coil circuit. The lamp further resembled the new Thomson lamp in having the series and shunt coils acting independently, the former only to strike and the latter only to feed.

THE WAX WHEEL LAMP.

The next lamp which I exhibit is an entire novelty in the English market, though already in extensive use in America. In it all clutches, escapements, springs, and dashpots are eliminated, the feeding being accomplished by the heating effect in a shunt. To a rack on the upper carbon rod is geared a spindle carrying between two ebonite cheeks a ring made of a white composition of wax. Into the edge of this ring is embedded the head of a fixed pin, which therefore prevents the wax wheel from turning. Upon the upper part of the pin is wound a coil of German silver wire, having a resistance of about 150 ohms, which is included along with an auxiliary resistance of some 800 more ohms in a shunt circuit. The current which flows through this shunt circuit, though small, is sufficient to warm the pin and cause it to soften the wax in its neighborhood, thus permitting the wax wheel to turn round very slowly, in fact about one revolution in two or three hours, but very uniformly. The melted wax solidifies at once after having passed the pin, so that the surface of the wax wheel is left even for the next revolution. The feeding is therefore continuous and very gradual. Should the arc grow long more current flows through the shunt, making the pin hotter and causing the feed to work quicker. The rate of feeding is found to be approximately proportional to the square of the voltage applied to the shunt. This lamp, the invention of Mr. S. E. Nutting, can be used with either alternating or continuous currents. The arc is struck from below by an electromagnet in the main circuit, placed at the bottom. In the latest pattern of this lamp there is an automatic rheostat to vary the resistance of the shunt circuit according to the temperature of the surrounding air; and an ingenious cut-out has been added for lamps designed to run in series.

LAMPS FOR OPTICAL LANTERNS.

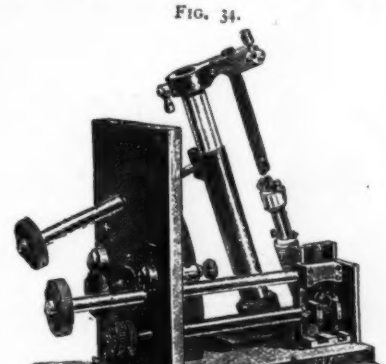
Since the distribution of electric current from lighting stations became general much attention has been given to the production of small projector lamps suitable for use in the optical lantern. These are now fast replacing the limelight, and every month sees the introduction of some new forms. The principle of making the ends of the carbon abut against a solid projection, as shown in Fig. 33, is an old one, but it has been revived by Brockie, Scharnweber, and others in lamps intended for use in optical lanterns. The form of abutment usually preferred is that of three obliquely projecting claws or screws, which grip the coned surface of the carbon. For the negative carbon, a steel abutment serves excellently. For the positive carbon abutments are less satisfactory, as they are comparatively liable to be burned away by the arc.

FIG. 33.

There are on the table, thanks to the kindness of several exhibitors, some of these modern small projector lamps suitable for lantern work. First, I ought to mention the one that has done good service during my lectures, Mr. Davenport's own, of which there are two or three varieties here. That which I have been using in the lantern has an abutment pole below, with a spring to press the lower carbon against the abutting screws. There is a hand feed behind to move the upper carbon; and there are little details of arrangement as shown in Fig. 34, for centering and raising the luminous point.

Then there are three lamps here made according to Major Holden's patent, kindly lent me by Messrs. Newton & Company, of Temple Bar. In these lamps abutment poles are used, either on the positive or negative carbons, or on both with sundry arrangements of mechanical value for changing the carbons and renewing them.

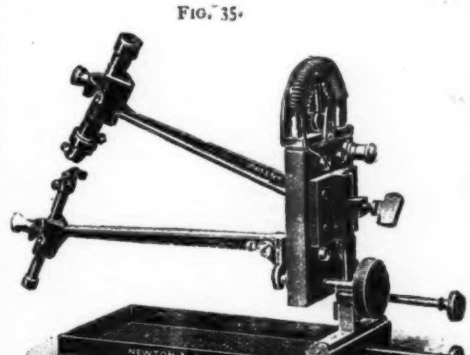
FIG. 34.



Here, in the first example, are some curious contrivances to enable one to unclamp either carbon and put in a new one, as you put a new candle in a carriage lamp. In this case one has a fine hand adjustment on the lower carbon and a coarse adjustment on the upper.

Here, again, is a somewhat similar type with hand adjustment above and below, if required. Having two sets of abutment poles, positive and negative, the carbons ought to approach at their proper rates, so that a very small amount of adjustment by hand ought to suffice. The third lamp (Fig. 35), which is of a squat pattern, is also Major Holden's. It has a device for centering, for raising and lowering the thing as a whole, and also for moving the lower carbon so as to lengthen out the arc or shorten it as desired.

FIG. 35.



Again, here is a little lamp, devised by Mr. Borland, of Leeds. It has all the elements of an arc lamp, in miniature. A coil to pull up a plunger and strike the arc, and a shunt coil to move another plunger to make the carbons approach one another. With carbons long enough to last four hours this lamp only weighs 3 lb. I have found it to work exceedingly well on a continuous current supply with an inverted arc, using as the lower pencil a soft cored carbon. The upper carbon, of smaller diameter and uncored, should be set slightly in front of the lower.

A very simple hand lamp with screw feed, by Mr. A.

J. Beaumont, of York, has lately claimed some notice; but I have not had any experience with it.

Mr. Brockie has designed a very perfect small projector lamp with a vibrating clutch feed, in which also abutment stops are provided for the negative carbon; but it belongs in reality to the class of lamps with complex mechanism, and, therefore, can scarcely be classed with the simple lamps just mentioned.

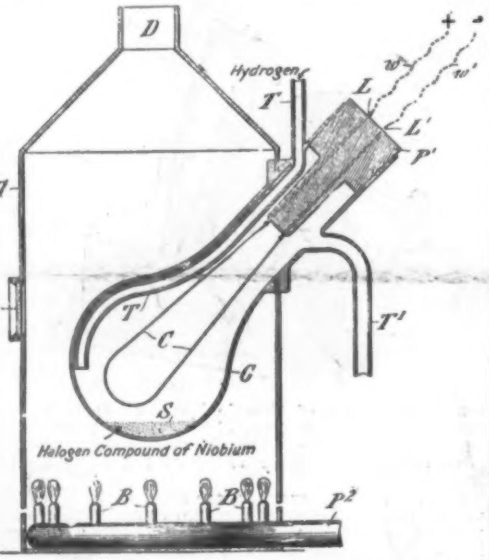
One thing has not yet been attained by the inventors of any of the automatic lamps, namely, the production of a lamp that, without any adjustment whatever, shall be capable of being connected up straight to the 100-volt mains of any lighting system, whether the supply be of the continuous or the alternate current sort. The fact is, the universal lamp, which will go anywhere with any sort of supply, has not yet been invented. Perhaps it never will come exactly in that form.

LAMPS FOR 100-VOLT CIRCUITS.

There is another direction in which progress has been taking place during the past few years, viz., in the perfection of lamps for the special purpose of running two in series on the ordinary 100-volt mains with continuous current. It is a curious fact that lamps which will work excellently when there are a lot of them in series supplied with a continuous current of fixed value, are often difficult to coax into good working, when put, two in series, across 100-volt mains. Some lamps will not work at all. The inventor, however, has turned his attention to the question, and it is now often one of the most important claims that his lamp will work well under these conditions. There is a somewhat similar problem how to make three lamps work in series when you have an alternating current-supply at 100 volts.

They only want 30 volts each, and therefore there ought to be room for three in series across 100-volt mains. The successful solving of that problem surely must depend on some very simple thing. Now that we have methods of testing the nicety of feed, and of adjusting the volts at which the feed will occur, clearly the time ought not to be very distant when one can say that the problem of making lamps to work satisfactorily, two or three in series on 100 volt mains, shall have been really finally solved. Mr. Brockie has remarked to me that none of the old lamps which have glycerine dashpots to prevent the top carbon moving downward quickly would ever perform this function, for if you would have two lamps to work satisfactorily, and not to go seesawing one against the other, the one burning dull when the other is bright, they must be capable of dropping their carbons down into contact at the same instant, so that one shall not get down before the other and strike its arc before the other is ready. They may move up slowly, but they must move down quickly. That is apparently one condition—possibly not the only condition—for the successful working of lamps in series.

Then I think I may conclude here, though time is all too brief for this review of progress since 1889, by saying that there are distinct lines of progress which have been traced in these six years, and that those lines of progress, although they may not yet have brought us everything we desire, nevertheless have witnessed the development of arc lighting into a condition where success has for almost every conceivable purpose been attained. It now remains only to perfect refinements for special purposes, such as those to which I have just alluded.



AYLSWORTH'S METHOD OF PREPARING NIOBIUM LAMP FILAMENTS.

AYLSWORTH'S NIOBIUM INCANDESCENT LAMP.

THOUGH carbon still maintains its hold as the material for incandescent electric conductors within lamps, nevertheless, attempts are still being made to substitute metallic filaments of high melting points. The most recent work of this kind, says the Electrical Engineer, to which we are indebted for this article, is that of Mr. J. W. Aylsworth, of Newark, N. J., who makes the incandescent conductor from such refractory metals as niobium, tantalum, molybdenum, titanium, zirconium and other metals of the same group.

The method by which the filament is prepared consists in heating a base or support in the vapor of a volatile halogen compound of the element which it is desired to deposit, and simultaneously mix it with a reducing gas, such as hydrogen.

In actual practice the process is carried out by means of the apparatus shown in the accompanying engraving. As will be seen, it consists of a heating chamber, A, provided with an outlet, D, for the products of combustion. The tube, T, admits the hydrogen gas under pressure and T' conveys away the resultant gases or vapors.

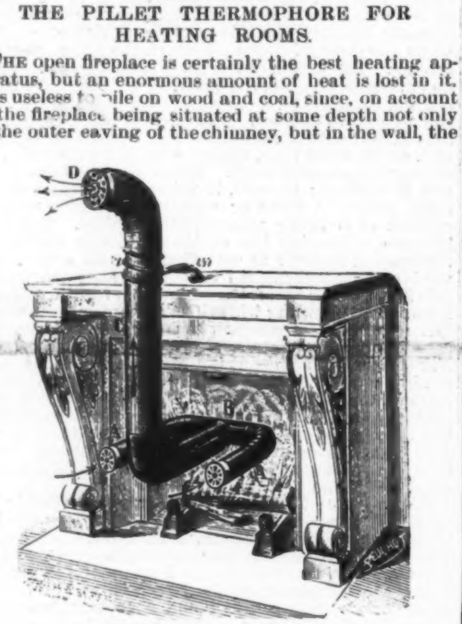
Mr. Aylsworth takes an ore of the metal to be treated—such, for instance, as columbite, a well known ore of niobium—and treats it by the well known chemical process for separating the oxides of such metals and obtains in this manner niobium oxide. After the oxide is thus separated from its ore it is converted into a volatile halogen compound by the well known application of mixing such oxides with charcoal and heating to a high degree of temperature in a current of dry halogen gas, such as chlorine or bromine. This halogen compound, S, is seen in position in the retaining vessel, G. The retaining vessel and its contents is then submitted to the heat of Bunsen burners and simultaneously a stream of a reducing gas, as hydrogen, is passed through the chamber by way of the inlet and outlet tubes, T and T'. A sufficient current of electricity is then passed through the conductors, w w, and the carbon or other base or support, C, to heat it to incandescence without rupture. There results from the union of the hydrogen gas and vapors arising from the halogen compound a deposit of the pure metal, as niobium, upon the filament base, C. This process is continued until the deposit reaches the desired thickness.

Halogen compounds of any of the highly refractory metals above referred to or any of the equivalent highly refractory metals may be used in place of the halogen compound of niobium, and the pure metals thereof deposited in the manner indicated. Mr. Aylsworth has succeeded in depositing in this manner tantalum, niobium, molybdenum, titanium and zirconium, continuing the process in each instance until the carbon core or other conducting filament is surrounded by the metal.

A niobium lamp prepared in the manner described above has been run on test for some months past and shows very high efficiency and long life.

THE PILLET THERMOPHORE FOR HEATING ROOMS.

THE open fireplace is certainly the best heating apparatus, but an enormous amount of heat is lost in it. It is useless to pile on wood and coal, since, on account of the fireplace being situated at some depth not only in the outer eaving of the chimney, but in the wall, the fire heats the room in which the chimney is placed only to a very slight degree. Only a very small portion of the heat produced radiates through the opening in the chimney casing, since the caloric contained in the gases of combustion really serves to assure the draught.



THE PILLET THERMOPHORE.

It is evident that the ideal arrangement would be a fireplace situated in the center of the room to be heated, and surrounded with walls as thin as possible. The air of the room would then be in contact with these walls and would be heated by them. This is what is tried with stoves, but the result is not happy, since gases that are more or less poisonous traverse the sides and become distributed through the atmosphere. There are other heating apparatus, especially hot air stoves, but such devices are very complicated and costly to set up.

What is needed is a means of turning chimneys to a better account (these having the advantage of not vitiating the atmosphere, since they assure a ventilation by drawing in air from the exterior), and also an arrangement allowing the chimney to heat the air of the room in which it is situated, after the manner in which water is heated over fire. This is precisely what is assured by a very curious system called a "Thermophore," and which is due to Mr. J. J. Pillet, one of our most scientific engineers. The apparatus in question has a very characteristic form, which will be understood from the figure. It is a stove pipe provided with two elbows and having nearly the shape of an S. This branches at the base into two pipes that form a large U and are arranged at the extremity of the horizontal branch of the large pipe. The thermophore may be fixed in front of any mantelpiece whatever by means of a spiral support, m n, and will remain in stable equilibrium, since its center of gravity is away beneath its point of support, n. Moreover, the lower or horizontal part may be raised or lowered at will according to the height or shape of the chimney casing, since the spiral support, m n, forms a spring upon the vertical pipe and is capable of sliding when slightly loosened.

The figure shows how the apparatus is placed with respect to the fireplace. The horizontal part, A B A, enters the flames and forms a genuine movable hot air stove, the operation of which is based simply upon the principle that the air always tends to ascend. In fact, the air contained in the part, A B A, becomes heated very quickly, and rising in C and then in D, is immediately replaced by cold air coming from the room and entering the horizontal branches of the U, as shown by the arrows. There is thus established a constant current, which escapes at D, and continually throws hot air into the room. All the air of the latter thus becomes heated by its passage through the center of the fireplace.—La Vie Scientifique.

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